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Clearwater Bay Area

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J.A. Ayer

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Foreword

Before 1986, geologic information available for the Clearwater Bay area was available only at a reconnaissance level. The detailed mapping described in this report is essential for an effective evaluation of the mineral exploration and land use potential of the map area.

The mapping project is one component of the Canada–Ontario Mineral Development Agreement (COMDA), which is a subsidiary agreement to the Economic and Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario. The Clearwater Bay project is one of several projects funded with the COMDA agreement and focussed on the Lake of the Woods area. This area is considered to have an excellent potential for the discovery of gold and base metals.

V.G. Milne

Director
Ontario Geological Survey

Contents

Abstract 2
Résumé 3
Introduction 4
Location and Access 4
Present Geological Survey 4
Previous Geological Work 4
Mineral Exploration 4
Physiography 4
Acknowledgments 5
General Geology 6
Archean 7
Metavolcanic and Metasedimentary Rocks 7
Mafic Metavolcanic Rocks 7
Lower Mafic Unit 7
Upper Mixed Unit 7
Petrography 7
Interpretation 9
Intermediate Metavolcanic Rocks 9
Flows 9
Debris Flows 10
Petrography 10
Interpretation 13
Felsic Metavolcanic Rocks 13
Petrography 15
Interpretation 15
Metasedimentary Rocks 15
Petrography 16
Interpretation 18
Metamorphosed Ultramafic and Mafic Intrusive Rocks 18
Petrography 18
Metamorphosed Felsic to Intermediate Intrusive Rocks 18
White Partridge Bay Group Metasedimentary Rocks 18
Interpretation 19
Pretectonic to Syntectonic Felsic to Intermediate Intrusive Rocks 19
Winnipeg River Subprovince 19
Winnetka Lake Stock 20
Ridge Lake Stock 20
Granite Lake Stock 21
Syntectonic to Late Tectonic Felsic Intrusive Rocks 21
Rush Bay Stock 21
Canoe Lake Stock 21
Mafic Intrusive Rocks 23
Proterozoic 23
Mafic Intrusive Rocks 23
Cenozoic 23
Quaternary 23
Pleistocene 23
Recent 23
Aeromagnetic Data 24
Petrochemistry 25
Volcanic Geochemistry 27

Lower Mafic Unit 27
Upper Mixed Unit 28
Synvolcanic Intrusive Rocks 34
Metamorphism 35
Structural Geology 36
Folding 36
Ductile Deformation 36
Faulting 37
Economic Geology 38
Gold 38
Copper, Molybdenum, Zinc 38
Description of Properties 38
Sampling by the field party 38
Argyle Occurrence 39
Echo Bay Occurrence 39
Echola Occurrence 39
Falconbridge Limited Property 42
Ash Bay Occurrence 43
Geroux Occurrence 44
Homestake Mineral Development Company Property 44
Rush Bay Occurrence 45
Homestead Occurrence 45
Hudson Bay Exploration and Development Company Limited 45
Inglis Lake Occurrence 45
Kerr Addison Mines Ltd. 45
Manitoba Consolidated Occurrence 47
Noranda Exploration Company, Limited Property 47
Nonesuch Occurrence 47
Gauthier Occurrence 47
Ogawa Bay Occurrence 49
G. Pogson Property (Three Friends Occurrence) 49
J.P. Rapski Property 49
Selco Exploration Company Limited 50
Squaw Lake Occurrence 50
Victoria Island Occurrence 51
Whiting Property (Unicorn Occurrence) 52
Recommendations for Future Exploration 53
References 54

TABLES

1. Table of lithologic units for the Clearwater Bay area. 8
2. Estimated modal mineralogy of metamorphosed felsic to intermediate intrusive rocks, Clearwater Bay area. 20
3. Estimated modal mineralogy of syntectonic to late tectonic felsic intrusive rocks, Clearwater Bay area. 21
4. Chemical analysis of samples from the Clearwater Bay area. 25
5. Description of analyzed samples from the Clearwater Bay area. 31
6. Grab sample assay values for samples collected during the 1986 field season in the Clearwater Bay area. 40
7. Grab sample assays, Inglis Lake occurrence, Clearwater Bay area. 46

8. Grab sample assays, G. Pogson property (Three Friends occurrence), Clearwater Bay area. 51

FIGURES

1. Location of the Clearwater Bay area. 4
2. Generalized lithostratigraphic and structural map of the Clearwater Bay area. 6
3. Sketch of ignimbrite outcrop on east side of Zigzag Island. 14
4. Sample locations for analyzed rocks from the Clearwater Bay area. 31
5. $Na_2O + K_2O$ versus SiO_2 diagram of volcanic and synvolcanic intrusive rocks from the Clearwater Bay area. 32
6. AFM diagram of volcanic and synvolcanic intrusive rocks from the Clearwater Bay area. 32
7. Jensen cation diagram of volcanic and synvolcanic intrusive rocks from the Clearwater Bay area. 32
8. Chondrite plot of REE for Lower Mafic Unit mafic volcanic rocks from the Clearwater Bay area. 32
9. Chondrite plot of REE for Upper Mixed Unit mafic volcanic rocks from the Clearwater Bay area. 33
10. Chondrite plot of REE for Upper Mixed Unit intermediate volcanic rocks from the Clearwater Bay area. 33
11. Chondrite plot of REE from the Upper Mixed Unit felsic ignimbrite horizon on Zigzag Island. 33
12. Chondrite plot of REE for felsic volcanic rocks from the Rat Portage Bay area. 33
13. Chondrite normalized plot of REE for synvolcanic intrusive rocks from the Clearwater Bay area. 34
14. Echo Bay occurrence. 43
15. Falconbridge Limited property (Ash Bay occurrence). 44
16. Inglis Lake occurrence. 46
17. Noranda Exploration Company, Limited property (Gauthier occurrence). 48
18. G. Pogson property (Three Friends occurrence). 50

PHOTOGRAPHS

1. Photomicrograph of quench-textured Lower Mafic Unit basalt. 9
2. Thinly banded intermediate flow from the east side of Ogema Bay. 10
3. Intermediate flow with irregular pillow (?) overlain by amygdaloidal flow with very large quartz-filled amygdules in subparallel alignment. .. 11
4. Intermediate pillow breccia northeast side of Ash Bay. 11
5. Close-up of a fragment from Photo 4. 12
6. Intermediate debris flow with angular to subrounded heterolithic fragments. 12
7. Intermediate debris flows. 13
8. Massive felsic volcanic rock (flow, tuff or sill) with polygonal columnar joints. 14
9. Felsic ignimbrite with interbedded tuff and very fine-grained cherty beds. 15

10. Photomicrograph of felsic tuff breccia with partly welded pumice, lithic clasts and quartz crystals. 16
11. Thinly to thickly bedded siltstones and feldspathic wackes cut by a mafic dike. 17
12. Iron formation with interbedded chert and argillite and highly disrupted chert beds. 17
13. Interbedded turbiditic conglomerates and thinly to thickly bedded wackes. 19
14. Photomicrograph of rapikivi-textured porphyritic quartz monzodiorite from the Rush Bay stock. 22
15. Lamprophyre dike containing rounded granitic and mafic inclusions cutting deformed pillowed metavolcanic rocks. 22

GEOLOGICAL MAP (back pocket)

Map 2549 – Precambrian geology, Clearwater Bay area ..... back pocket

CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.

Precambrian Geology
Clearwater Bay Area

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Abstract

The Clearwater Bay area is located in the northwestern part of Lake of the Woods: the centre of the area is about 20 km southwest of Kenora. The map area covers approximately 220 km².

All rocks are Archean in age except for a northwest-trending Proterozoic diabase dike.

The supracrustal rocks are within the Wabigoon Subprovince and consist of easterly trending metavolcanic and metasedimentary rocks. These rocks have been subdivided into three stratigraphically distinct units: 1) the oldest has been designated the Lower Mafic Unit, which consists of pillowed to massive flows of tholeiitic basalt; 2) overlying the Lower Mafic Unit is a diverse, predominantly volcanic, succession designated the Upper Mixed Unit; the Upper Mixed Unit consists of tholeiitic basalt flows, calc-alkalic basaltic andesite to andesite flows, debris flows, felsic pyroclastic rocks and minor intercalated clastic to chemical sedimentary rocks; 3) sedimentary rocks of the White Partridge Bay Group overlie the Upper Mixed Unit in the northeast. In the map area, only the lowermost part of the group is present. This part consists of wackes, mudstones and siltstones with minor interbedded turbiditic conglomerates. This group is interpreted to be composed of Timiskaming-type sedimentary rocks unconformably overlying the volcanic rocks of the map area.

The Lower Mafic and Upper Mixed units, but not the White Partridge Bay Group, are intruded by the following: synvolcanic ultramafic to mafic, differentiated to undifferentiated sills, and intermediate to felsic porphyry dikes, sills and small stocks.

A series of tight, east-trending to northeast-trending fold axes and a broad anastomosing shear zone in the south (designated the Crowduck Lake–Witch Bay shear zone) are the dominant structural elements of the area.

Granitic gneisses of the Winnipeg River Subprovince occur in the north with abrupt, uncomformable or tectonic contacts in the east and intrusive contacts in the west.

Granitic intrusions consist of the pretectonic Winnetka Lake and Ridge Lake stocks, the syntectonic Granite Lake and Rush Bay stocks, and the late tectonic Canoe Lake stock.

Gold occurs in two distinct structural settings in the map area: 1) quartz veins in narrow zones of brittle to ductile deformation with limited alteration, and 2) widely dispersed in broad zones of ductile deformation with widespread alteration.

Porphyry-type copper-molybdenum-zinc mineralization is associated with the Canoe Lake stock.

Résumé

Le secteur de Clearwater Bay est situé dans la partie nord-ouest de Lake of the Woods et son centre se trouve à environ 20 km au sud-ouest de Kenora. Le secteur cartographié couvre environ 220 km².

Toutes les roches sont d'âge archéen à l'exception d'un dyke de diabase Protérozoique d'orientation nord-ouest.

Les roches supracrustales se trouvent au sein de la sous-province de Wabigoon et sont constituées de roches métavolcaniques et métasédimentaires orientées vers l'est. Ces roches ont été subdivisées en trois unités stratigraphiques distinctes. 1) La plus ancienne a été appelée l'unité mafique inférieure consistant en coulées de basalte tholéiitique massives et à coussinets. 2) Reposant sur l'unité mafique inférieure, se trouve une succession diverse, surtout volcanique, désignée comme l'unité supéErieure mixte. Celle-ci comprend des coulées de basalte tholéiitiques, des coulées calco-alcalines de basalte andésitique à andésitique, des coulées boueuses, des roches pyroclastiques felsiques et quelques intercalations de roches sédimentaires clastiques à chimiques. 3) Au nord-est, des roches sédimentaires du groupe de Partridge Bay sont sus-jacentes à l'unité supérieure mixte. Dans le secteur cartographié, seule la partie inférieure du groupe est présente. Elle est constituée de grauwackes, de mudstones et de siltstones avec des interstratifications mineures de conglomérats turbiditiques. Ce groupe est interprété comme étant composé de roches sédimentaires de type Timiskaming reposant de façon discordante sur les roches volcaniques du secteur cartographié.

Des filons-couche syn-volcaniques ultramafiques à mafiques différenciés à non-différenciés et des dykes, filons couche et des petits massifs porphyritiques de composition intermédiaire à felsique, pénètrent les unités inférieure mafique et supérieure mixte mais pas le groupe de Partridge Bay.

Une série de plis sérrés avec des axes orientés vers le nord-est et une large zone de cisaillement anastomosé dans le sud du secteur (désignée la zone cisaillée de Crowduck Lake-Witch Bay) sont les éléments structuraux dominants de la région.

Des gneiss granitiques de la sous-province de Winnipeg River se trouvent dans la partie septentrionale avec des contacts abrupts, discordants ou tectoniques à l'est et des contacts intrusifs à l'ouest.

Des intrusions granitiques comprennent les massifs antétectoniques de Winnetka Lake et de Ridge Lake, les massifs syn-tectoniques de Granite Lake et de Rush Bay et le massif tardi-tectonique de Canoe Lake.

Dans le secteur cartographié, l'or se trouve dans deux environements structuraux distincts: 1) en association avec des veines de quartz et des zones de déformation cassantes à ductiles avec une faible alteration. 2) dispersé dans de larges zones de déformation ductile ayant subi une altération étendue.

Une minéralisation en cuivre-molybdène-zinc de type porphyrique est associée avec le massif de Canoe Lake.

Ayer, J.A. 1990. Precambrian geology, Clearwater Bay area; Ontario Geological Survey, Report 280, 55p.

Introduction

Location and Access

The Clearwater Bay area lies in the northwestern part of Lake of the Woods about 20 km southwest of Kenora in the District of Kenora. An area of about 220 km² was covered at 1 inch to 1/4 mile scale (1:15 840) approximately bounded by latitudes 49°37'00"N to 49°45'00"N and longitudes 94°40'00"W and 94°53'00"W (Figure 1).

Access to much of the area is by water from the Lake of the Woods. The northern part can be accessed from Highway 17 and numerous secondary roads.

Present Geological Survey

Field mapping was conducted during the summer of 1986. Mapping in the area is a westward extension of mapping in the northern part of Lake of the Woods. This was begun in the Bigstone Bay area in 1984 (Ayer et al. 1985), and continued in the north-central part in the Rat Portage Bay area in 1985 (Ayer and Gil 1986). Mapping was at a scale of 1 inch to 1/4 mile (1:15 840). Outcrop data was recorded on aerial photographs and transferred to Ontario Base Map cronaflexes corrected to a scale of 1 inch to 1/4 mile. Mapping was concentrated on shoreline exposures. Inland pace and compass traverse lines were spaced at about 400 m intervals, but were also oriented to examine the maximum amount of outcrop perpendicular to the regional strike.

Previous Geological Work

The first complete geological map of the Lake of the Woods was by Lawson (1885). Lawson introduced the term Keewatin for the Archean supracrustal rocks in the Lake of the Woods.

Coste (1895) and Coleman (1895, 1896) visited various properties within the map area and reported on mining activities.

The western part of the map area was mapped at a scale of 1 inch to 1 mile (1:63 360) by Greer (1931).

The eastern part of the area was covered at a scale of 1 inch to 1 mile (1:63 360) by Thomson (1937). Thomson proposed that the Archean sedimentary rocks in northeastern Clearwater Bay were equivalent to Timiskaming strata, i.e., unconformably overlying the Keewatin "greenstones".

Stratigraphic studies, with emphasis on lithogeochemistry of volcanic rock units, were conducted in the eastern part of the map area by Goodwin (1965, 1970) as part of large scale investigations of the western Wabigoon Subprovince.

Geological mapping at a scale of 1 inch to 1/4 mile (1:15 840) has been completed by Ontario Government geologists in the vicinity of the map area as follows: to the west by Davies (1965); to the south and southwest by Davies (1978, 1982); and to the east by the author (Ayer and Gil 1986).

Mineral Exploration

The area has been intermittently explored for gold since the Lake of the Woods gold rush in the 1880s. During the "rush", many small shafts, pits and trenches were excavated in the map area. Some of these pits probably produced small amounts of gold. No gold production figures, however, are on record for any of the properties in the map area.

Much of the northern part of Lake of the Woods, including the map area, was covered by large scale airborne geophysical exploration for base metals in the 1960s and 1970s. Some of the more significant geophysical anomalies were followed up by diamond drilling and gave generally discouraging results.

The area underlain by the Canoe Lake stock, including that part within the southwestern part of the map area, has been explored for porphyry copper mineralization since the late 1960s.

In recent years, since the mid 1970s, interest in gold exploration in the area has been revitilized. Exploration work since this period has included airborne and ground geophysical surveys, geochemical surveys, detailed geological mapping, stripping, trenching and sampling. Much of the detailed work is in the vicinity of previously recognized gold properties.

Physiography

The elevation of the Lake of the Woods averages about 323 m above m.s.l. The topography of this area is moderately rugged with abundant outcrop exposed along a

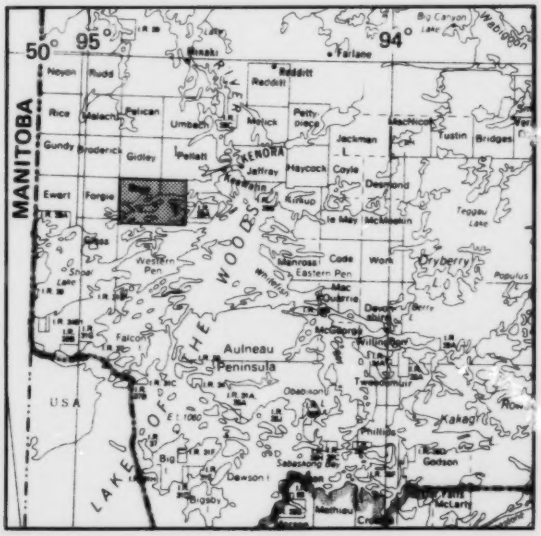


Figure 1. Location of the Clearwater Bay area, scale 1:1 584 000.

highly indented shoreline; the frequency of exposures in in the interior is variable. Outcrop is most abundant over the granitic bodies. Elevation achieves a maximum of about 396 m above m.s.l. in the north where orthogneisses of the English River Subprovince are exposed.

Areas of swamp are small; these areas generally do not exceed more than 2 km². Numerous small lakes occur on the land surrounding and draining into the Lake of the Woods. Lakes in the north-central and northeast part of the map area drain northeast into the Winnipeg River.

Acknowledgments

The writer was assisted by J.M. Sweeny, M.J. Michaud, D. Rowe, C.W. McKeachie and H. Tumanowski. J.M. Sweeny, as senior assistant, was responsible for about one half of the mapping and in particular for much of the mapping of the large granitoid bodies.

Thanks are extended to Michael Flanagan of Homestake Mineral Development Company for access to company airborne geophysical data and for helpful discussions on the geology of the map area.

General Geology

A generalized distribution of lithologic units and structures in the map area is presented in Figure 2. Supracrustal rocks belong to three stratigraphically distinct groups.

1. The oldest is designated the Lower Mafic Unit and consists of pillowed to massive mafic flows.
2. A middle group designated the Upper Mixed Unit consists of mafic to intermediate, pillowed to massive flows, heterolithic debris flows and felsic pyroclastic rocks. The volcanic rocks are locally intercalated with clastic and chemical sedimentary rocks.
3. An uppermost group of Timiskaming-type sedimentary rocks designated the White Partridge Bay Group unconformably overlies the Upper Mixed Unit. In the map area, this group consists predominantly of fine-grained, turbiditic wackes, siltstones and mudstones representing the basal part of the group. East of the map area, a more complete stratigraphic section shows coarsening upwards into medium-grained, massive to cross-bedded sandstones and conglomerates with granitoid pebbles (Ayer 1987).

The Lower Mafic and Upper Mixed units, but not the White Partridge Bay Group, are intruded by synvolcanic mafic to ultramafic differentiated sills, and felsic to intermediate porphyry dikes, sills and small stocks.

Metamorphic grade ranges from greenschist facies throughout most of the map area to amphibolite facies in the north, adjacent to the Winnipeg River Subprovince orthogneisses.

The intrusion of granitic rocks occurred at several times in the area. The oldest granitic rocks are pretectonic, tonalitic to granodioritic gneisses of the Winnipeg River Subprovince in the northern part of the map area (Clark et al. 1981). In the north-central part of the map area, orthogneisses are in direct intrusive contact with mafic metavolcanic rocks of the Lower Mafic Unit. To the east, a marginal unit of alkali feldspar megacrystic granodiorite is in abrupt contact with the Lower Mafic Unit. This marginal unit grades to the north into orthogneisses. In the west, pretectonic quartz monzodiorite to granodiorite and diorite of the Winnetka Lake stock are in intrusive contact with the Lower Mafic Unit, and grade into orthogneisses to the north. The Ridge Lake stock is also pretectonic; it has a similar composition to, and may be an apophysis of, the Winnekta Lake stock.

The Granite Lake stock is syntectonic. It consists of homogeneous, alkali feldspar megacrystic granodiorite intruded into metavolcanic rocks, with a thin septum of

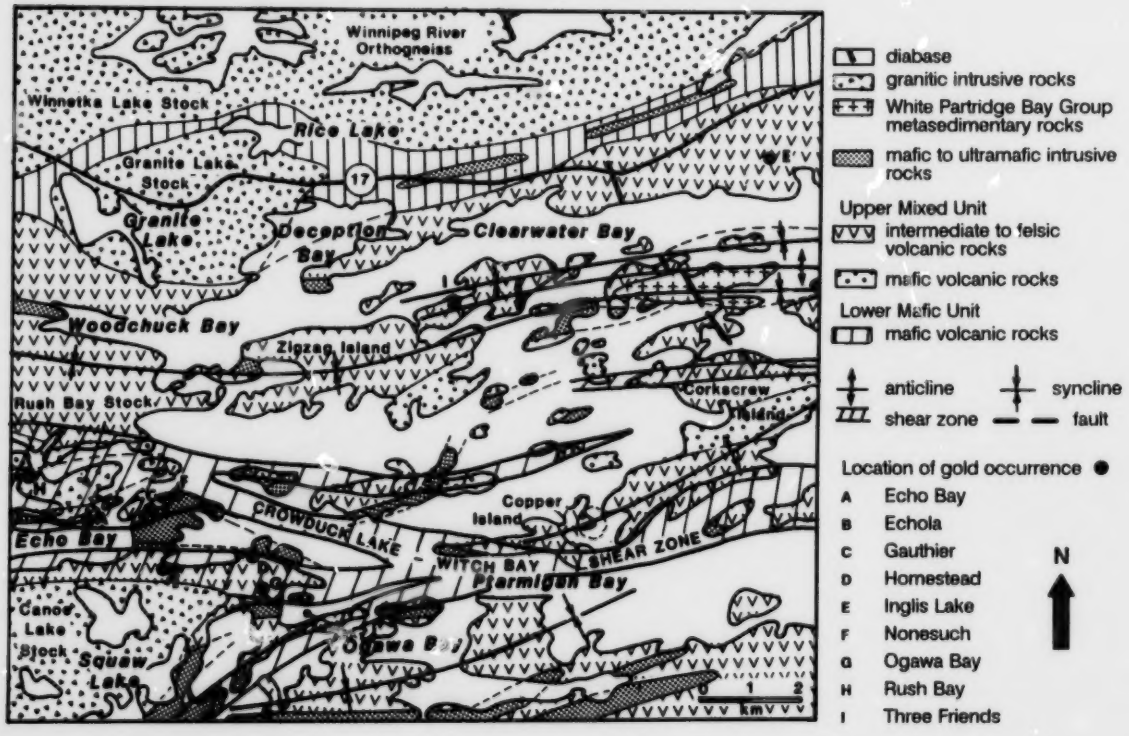


Figure 2. Generalized lithostratigraphic and structural map of the Clearwater Bay area.

amphibolitized mafic metavolcanic rocks of the Lower Mafic Unit separating it from the Winnetka Lake stock to the north.

The Rush Bay stock is also syntectonic. This stock consists of Rapakivi-textured plagioclase and alkali feldspar porphyritic quartz monzodiorite intruded intc metavolcanic rocks in an extensive zone of high strain known as the Crowduck Lake–Witch Bay shear zone.

The Canoe Lake stock is late tectonic. This stock consists of equigranular to porphyritic tonalite. The hydrothermal alteration in the stock ranges from extensive propylitization to localized phyllitic and restricted potassic alteration.

Minor, late Archean kersantite lampyrophyre dikes cut the volcanic rocks and granitoid rocks in the southern half of the map area.

A large, early Proterozoic diabase dike trends northwesterly across the northeast part of the map area. This dike belongs to the Kenora–Kabetogoma swarm, which has been dated at about 2.1 Ga (Halls 1982, 1986).

Table 1 lists the lithologic units present in the Clearwater Bay area. The detailed geology of the area is shown on Map 2549 (back pocket).

ARCHEAN

METAVOLCANIC AND METASEDIMENTARY ROCKS

Mafic Metavolcanic Rocks (unit 1)[1]

LOWER MAFIC UNIT

Mafic volcanic rocks represent a relatively minor proportion of the volcanic rocks in the map area. These rocks occur in two distinct stratigraphic positions within the map area. The oldest rocks occur within the western extension of the Lower Mafic Unit identified in the Bigstone Bay and Rat Portage Bay areas to the east of the map area (Ayer et al. 1985; Ayer and Gil 1986). The Lower Mafic Unit volcanic rocks are most abundant in the north in a band up to 1 km wide trending northeast across the map area roughly parallel to Highway 17. A minor amount of Lower Mafic Unit volcanic rocks also occurs in various localities in the south (Figure 2). However, here, the mafic flows are extensively intruded by differentiated mafic sills.

Rocks of the Lower Mafic Unit are typically aphyric, pillowed to massive basaltic flows. Local horizons of porphyritic basalt with coarse-grained equant plagioclase phenocrysts up to 2 cm in size are restricted to the northern band, near the stratigraphic top of the Lower Mafic Unit in the vicinity of Deception Bay. The porphyritic basalts occur as fine-grained pillowed to massive flows, and medium-grained gabbroic-textured sills or thick massive flows.

In the north part of the map area, flows of the Lower Mafic Unit are fine grained and dark brownish green on weathered surfaces. Locally, thin, darker green pillow selvages are preserved. Pillows are generally highly flattened and are up to 3 m long and 50 cm thick.

Extensive metamorphic recrystallization to lower amphibolite facies has obliterated much of the finer scale primary texture in the groundmass of the flows.

In the south, the mafic volcanic rocks of the Lower Mafic Unit are less recrystallized within the greenschist facies of regional metamorphism. These rocks occur as fine-grained, dark green to buff weathering, pillowed to massive flows. Pillows are rounded and as much as 1 m thick. Selvages are thin, dark coloured and locally have medium-grained varioles concentrated toward the pillow rims. South of Ash Bay,in the south-central part of the map area, a quench texture is preserved in massive and pillowed flows. The texture consists of coarse-grained branching and radiating mafic crystals (presently altered to tremolite-actinolite) up to several centimetres long in a fine-grained groundmass of plumose radiating actinolite intergrown with elongate plagioclase crystals (Photo 1).

Hyaloclastite, pillow and flow breccias were observed in the Lower Mafic Unit in its northern and southern exposures.

UPPER MIXED UNIT

Mafic volcanic rocks also occur within the Upper Mixed Unit, which is intercalated with intermediate to felsic volcanic rocks. The thickest concentration is in the east-central part of the map area and may extend (under water) to join with thinner mafic bands in Rush Bay in the west-central part of the map area. These rocks also occur in the eastern part of Ptarmigan Bay and in minor amounts in various other localities in the Upper Mixed Unit.

Mafic metavolcanic rocks within the Upper Mixed Unit occur as pillowed to massive flows. They are aphyric to plagioclase-phyric, have fine-grained lath-shaped phenocrysts, and are commonly amygdaloidal, with fine- to medium-grained carbonate and/or quartz-filled vesicles. These volcanic rocks are fine-grained and medium green to dark greenish brown on weathered surfaces. Pillows are rounded and up to 1 m thick with thin dark green selvages. Locally, the pillowed flows are variolitic with lighter green spheroids up to 5 mm in size, which tend to coalesce in irregular patches up to 30 cm long in the pillow cores. Breccias consisting of interpillow hyaloclastite, pillow breccia and flow breccia are locally present.

Thus, mafic flows of the Upper Mixed Unit contrast with the Lower Mafic Unit in that they are generally plagioclase-phyric, amygdaloidal, weather a different colour and are commonly variolitic.

PETROGRAPHY

Lower Mafic Unit mafic metavolcanic rocks are typically fine-grained and aphyric, consisting of felted masses

[1] *Lithologic unit numbers used throughout this report refer to those on Map 2549 (back pocket).*

TABLE 1. TABLE OF LITHOLOGIC UNITS FOR THE CLEARWATER BAY AREA.

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Glacial, glaciofluvial, stream, lake and swamp deposits

Unconformity

PRECAMBRIAN

PROTEROZOIC

APHEBIAN

Mafic Intrusive Rocks

Diabase

Intrusive Contact

ARCHEAN

Mafic Intrusive Rocks

Biotite lamprophyre

Intrusive Contact

Syntectonic to Late Tectonic Felsic Intrusive Rocks

Tonalite, porphyritic tonalite, quartz monzodiorite, felsite

Intrusive Contact

Pretectonic to Syntectonic Felsic to Intermediate Intrusive Rocks

Granodiorite and tonalite gneiss, megacrystic granodiorite, quartz monzodiorite, granodiorite, diorite

Intrusive Contact

White Partridge Bay Group

Metasedimentary Rocks

Feldspathic wacke, quartz wacke/tuff, mudstone, siltstone, conglomerate/tuff breccia

Unconformity

Metamorphosed Felsic to Intermediate Intrusive Rocks

Feldspar ± quartz ± amphibole porphyry, felsite

Intrusive Contact

Metamorphosed Mafic Intrusive Rocks

Melagabbro, gabbro, leucogabbro, quartz gabbro, quartz diorite

Gradational Contact

Metamorphosed Ultramafic Intrusive Rocks

Peridotite and pyroxenite

Intrusive Contact

Metavolcanic and Metasedimentary Rocks

Metasedimentary Rock

Feldspathic wacke, mudstone, siltstone, chert, sulphide iron formation, silicate–magnetite iron formation

Felsic Metavolcanic Rock

Tuff, lapilli tuff, tuff breccia, pyroclastic breccia, quartz–feldspar crystal tuff

Intermediate Metavolcanic Rock

Tuff, lapilli tuff, tuff breccia, pyroclastic breccia, plagioclase ± quartz crystal tuff, pillowed flow, massive flow, amygdaloidal flow, flow breccia, pillow breccia, hyaloclastite

Mafic Metavolcanic Rock

Massive flow, pillowed flow, amygdaloidal flow, variolitic flow, plagioclase porphyritic flow, flow breccia, pillow breccia, hyaloclastite, tuff/lapilli tuff/tuff breccia

Photo 1. Photomicrograph of quench-textured Lower Mafic Unit basalt. Acicular amphibolitized mafic phenocrysts with cores and swallow-tailed terminations of groundmass material. Groundmass consists of fine-grained plumose intergrowth of amphibole and plagioclase. Crossed polars, field of view 6.25 mm. Sample 86 JAA 0359; south shore of Ash Bay.

of subhedral to euhedral actinolite-temolite (up to 70 percent), subhedral plagioclase (up to 30 percent) overgrown by very fine-grained epidote and are with or without accessory or trace amounts of carbonate, chlorite, epidote, titanite and opaque minerals.

South of Ash Bay, some of the massive and pillowed flows contain up to 30 percent coarse-grained, branching and radiating euhedral mafic crystals, interpreted by the author to be primary quenched phenocrysts up to several centimetres long (Photo 1), replaced by fine-grained tremolite. These occur in a fine-grained groundmass of plumose felted intergrowths of subhedral actinolite or tremolite and plagioclase.

A thin section of a massive medium-grained plagioclase porphyritic mafic sill or massive flow from Deception Bay contains medium to coarse, equigranular, euhedral, primary plagioclase phenocrysts of labradorite composition (An_{70}) in a subophitic groundmass of secondary, medium-grained poikilitic amphibole (actinolite or tremolite after pyroxene) having inclusions of fine-grained groundmass plagioclase.

Mafic flows within the Upper Mixed Unit commonly contain up to several percent fine-grained, euhedral, lath-shaped plagioclase phenocrysts (up to 1 mm in size). These flows occur in a very fine-grained groundmass of trachytic to pilotaxitic, euhedral, altered plagioclase microlites intergrown with subhedral amphibole and/or chlorite with accessory to trace amounts of carbonate, quartz, epidote, titanite and opaque minerals. Plagioclase content ranges up to a maximum of about 50 percent of the rock. Plagioclase is typically strongly altered to albite with overgrowths of very fine-grained epidote.

INTERPRETATION

The pillowed nature and general absence of vesicles in the flows of the Lower Mafic Unit suggest deposition in submarine conditions in relatively deep water, i.e., greater than 2000 m (Jones 1969). The presence of amygdules in mafic flows from the Upper Mixed Unit indicates a relatively shallower depth of emplacement for the Upper Mixed Unit than the Lower Mafic Unit.

Intermediate Metavolcanic Rocks (unit 2)

Rocks of this unit belong to the Upper Mixed Unit, which consists of a diverse assemblage of mafic to felsic volcanic rocks conformably or disconformably overlying the Lower Mafic Unit. Two main varieties of intermediate volcanic rocks occur within the map area. These are: pillowed to massive, plagioclase porphyritic flows, and heterolithic, volcanic debris flows.

FLOWS

Flows are most abundant in a band up to 2 km wide trending east northeast across the central part of the map area, from south of Woodchuck Bay to Corkscrew Island. In this band, pillows can be very large. South of Woodchuck Bay, pillows up to 12 m long and 4 m thick were observed.

The intermediate flows are fine grained and green to buff grey on weathered surfaces. Pillow selvages are thick (up to 1 cm) and lighter in colour than the pillow

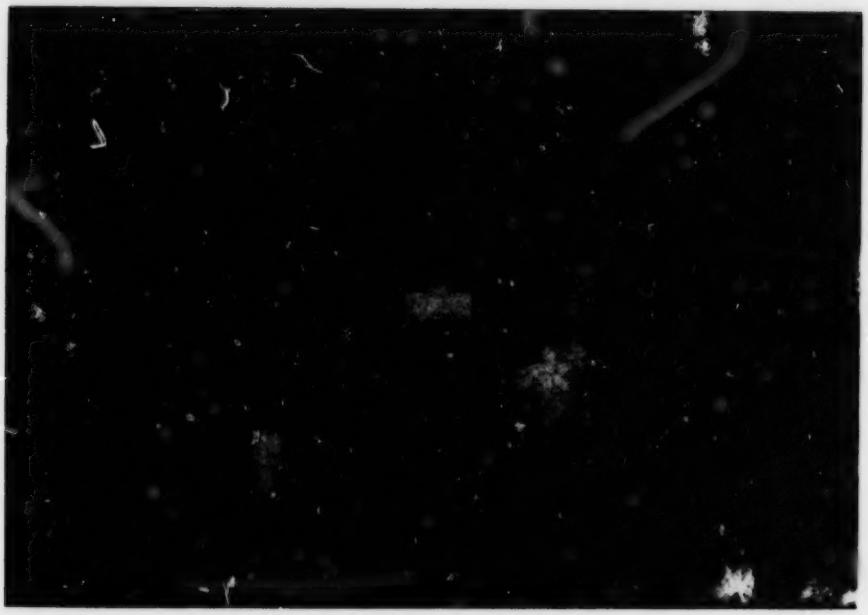


Photo 2. Thinly banded intermediate flow from the east side of Ogema Bay.

cores. Amygdules are common and range from 0.1 to 10 cm in size. The amygdules are typically filled with carbonate with or without quartz, chlorite, epidote and opaque minerals. On the northwest side of Ash Bay, radiating fractures were observed extending from pillow cores into spherical, medium-grained vesicles concentrated around the pillow rims.

Flows along the east shore of Ogema Bay are very fresh in appearance and many primary textures are preserved. In this locality, finely laminated banded flows (Photo 2) are intercalated with pillowed flows. Also, highly irregular pillows(?) are intercalated with flows with abundant very large amygdules (up to 10 cm in size) that are aligned parallel to the flow direction (Photo 3).

Locally, flows grade upwards and laterally into isolated pillows and brecciated pillows in hyaloclastite. Sea floor alteration appears to have affected some of these breccias. Light grey (bleached?) hyaloclastite occurs on the northeast side of Ash Bay (Photo 4). Observation of some of the fragments indicates alteration rinds which are discontinuous around fragments (Photo 5). This is an indication that the brecciation occurred after the alteration.

DEBRIS FLOWS

Intermediate debris flows consist of heterolithic, angular to subrounded fragments (Photo 6) in a fine-grained matrix with abundant crystals. Clasts range from mafic to felsic, but are of predominantly intermediate, composition. Clasts are porphyritic to non-porphyritic, amygdaloidal to non-amygdaloidal flow fragments; crystal-rich tuffaceous fragments; and fine-grained, equigranular fragments of synvolcanic intrusive and/or flow origin. The fragments range up to 1 m in size, but are mostly in the block to lapilli size range. Locally, the coarser fragmental rocks are interbedded with fine-grained, crystal-rich or very fine-grained, thin, laminated bedded tuffs (Photo 7).

Certain characteristics of these fragmental deposits favour their interpretation as debris flows or redeposited volcaniclastic deposits rather than as primary unreworked pyroclastic rocks. These include the nature of the clasts (i.e., heterolithic and predominantly of flow origin), the normal grading within depositional units, and the finely laminated to bedded tops of some of the depositional units. These criteria, documented in more detail in reports from the Bigstone Bay area (Ayer et al., in press), suggest they were deposited as subaqueous debris flows after the criteria of Fisher (1982).

PETROGRAPHY

Intermediate flows are commonly plagioclase porphyritic with up to 30 percent fine- to coarse-grained, lath-shaped euhedral phenocrysts up to 1 cm in length. Plagioclase also occurs as very fine- to fine-grained euhedral to subhedral microlites in the groundmass, with either a subparallel trachytic or random pilotaxitic texture. Plagioclase can constitute as much as 80 percent of the rock and is commonly altered to very fine-grained epidote with or without sericite, and carbonate. Unaltered plagioclase phenocrysts range in composition from oligoclase to andesine. The groundmass consists of very fine-grained to fine-grained subhedral amphibole with or without chlorite, quartz and biotite, with accessory to trace carbonate, epidote, titanite and opaque minerals.

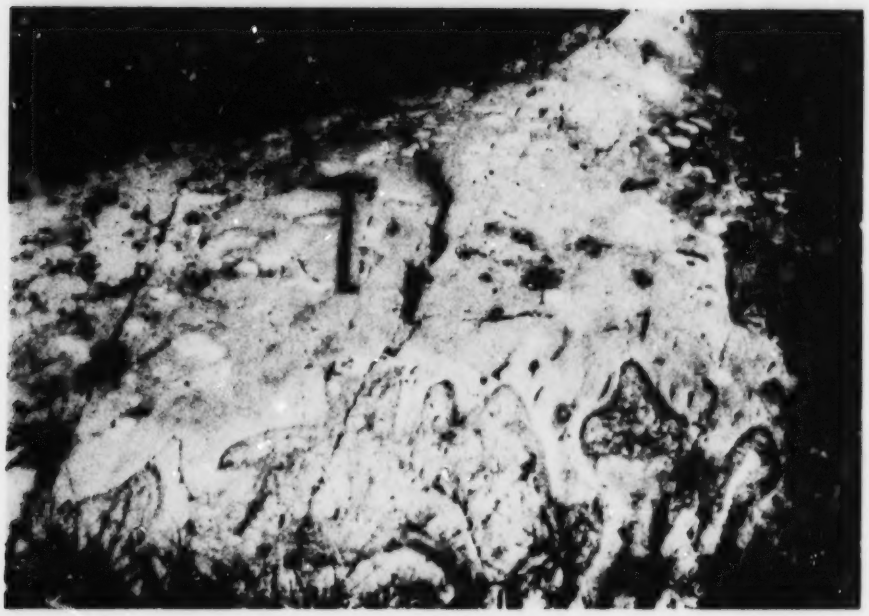


Photo 3. *Intermediate flow with irregular pillow (?) overlain by amygdaloidal flow with very large quartz-filled amygdules in subparallel alignment. Outcrop on the east side of Ogema Bay. Hammer handle is 40 cm long.*

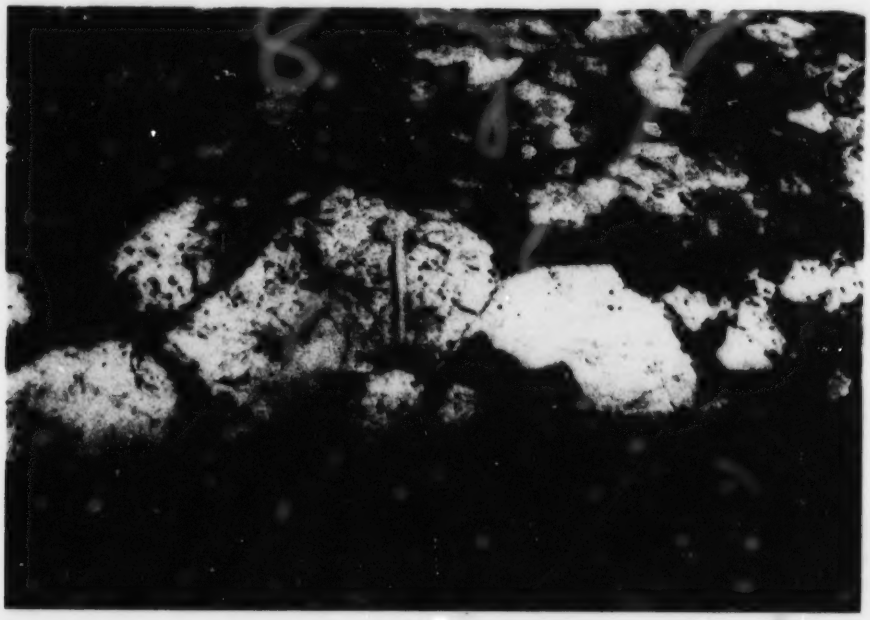


Photo 4. *Intermediate pillow breccia, northeast side of Ash Bay. Large pillow and fragments are bleached and the matrix is chloritized. Facing direction is to the left as indicated by the pillow with the scale hammer. Hammer handle is 40 cm long.*

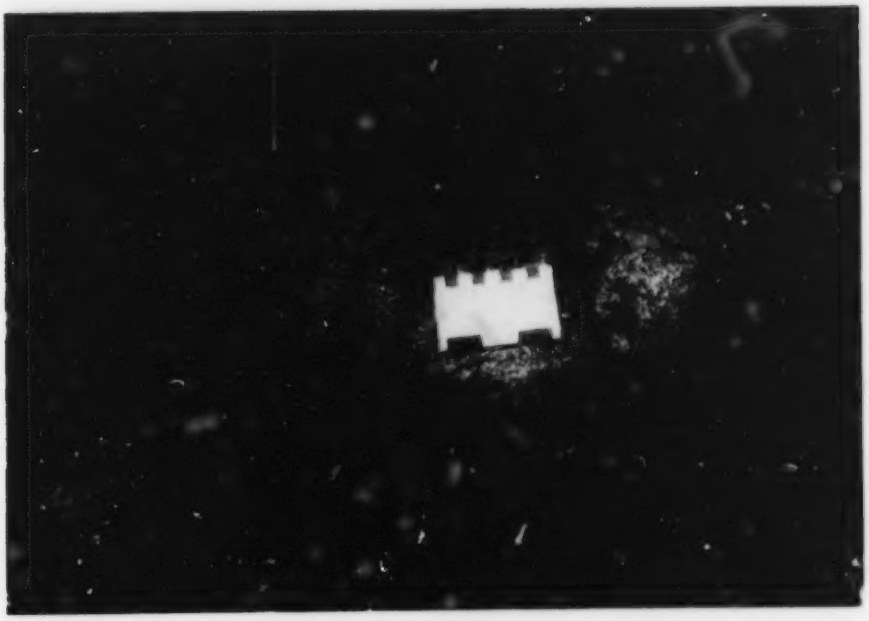


Photo 5. *Close-up of a fragment from Photo 4 showing an alteration rind which developed on one side of the pillow fragment (lower side) prior to brecciation.*

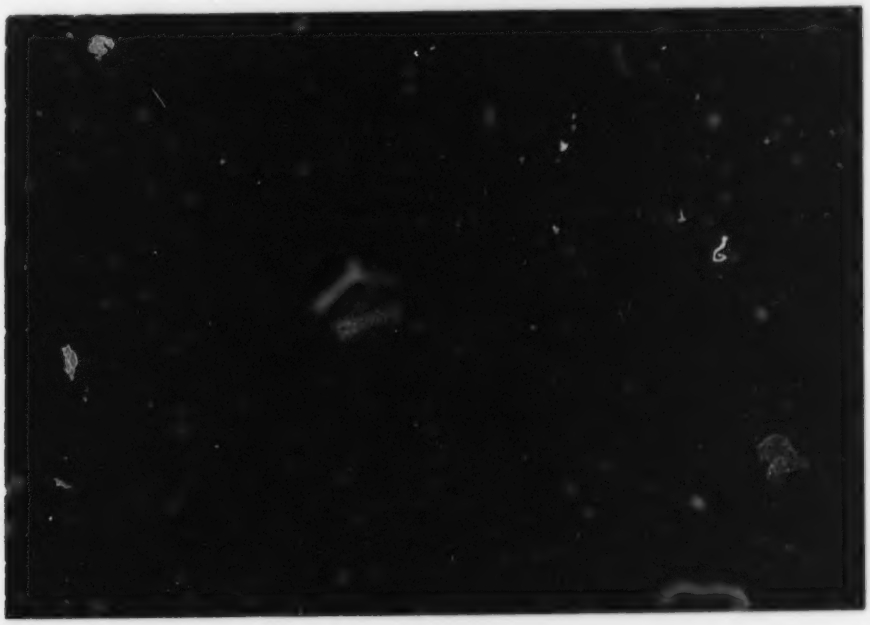


Photo 6. *Intermediate debris flow with angular to subrounded heterolithic fragments. Outcrop northeast of Ash Bay.*

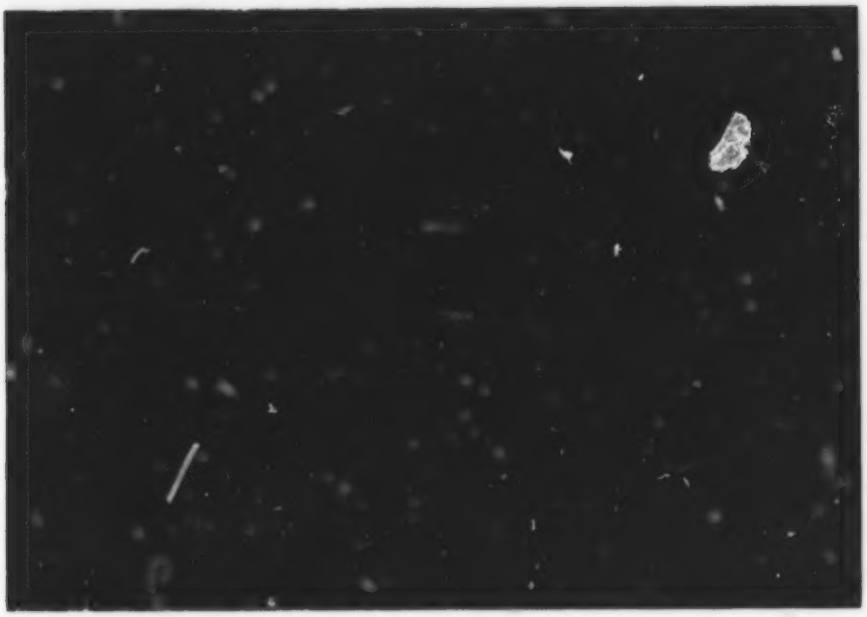


Photo 7. Intermediate debris flows: interbedded lapilli tuffs (right side), tuff breccias (centre), and thinly bedded tuffs (left side). Outcrop on Highway 17, just south of Hinterland Lake.

Amygdaloidal flows and associated debris flows exposed along the north shore of Clearwater Bay, east of McCallum Point, contain anomalous biotite (up to 25 percent). This and the presence of several mineral occurrences in this area (*see* Argyle Occurrence and Manitoba Consolidated Occurrence) suggests potassium metasomatism for this area.

Locally, along the north shore of Clearwater Bay, the groundmass of intermediate flows, debris flows and volcanic intrusions are overgrown by fine-grained, euhedral actinolite porphyroblasts. This was only observed north of Clearwater Bay. This indicates an increasing thermal metamorphic grade within the "greenstones" in the northern part of the map area.

Debris flows contain angular to subrounded lithic clasts consisting of porphyritic and aphyric flows, crystal-bearing tuffaceous clasts, and a minor amount of fine-grained, subhedral, granular-textured plagioclase-rich rocks which may be of either massive flow and/or synvolcanic intrusive origin. The fragments occur with angular broken crystals of plagioclase, minor mafic crystals (altered to amphibole or chlorite) and quartz. The matrix consists of very fine-grained to fine-grained plagioclase, quartz and chlorite with or without amphibole and biotite, with accessory to trace amounts of carbonate, epidote and opaque minerals with or without sericite and titanite.

INTERPRETATION

A subaqueous depositional environment is clearly indicated for the intermediate volcanic rocks from the intercalation of pillowed flows, sediments and debris flows. These show characteristics of subaqueous deposition such as normal grading and bedded tops (Fisher 1982).

The abundance and size of vesicles in the lava flows suggests a relatively shallow water environment particularly in comparison with the non-amygdaloidal flows in the underlying Lower Mafic Unit (cf., Jones 1969).

The intimate intermixture of lava flows and debris flows also suggests that these two types of lava were deposited contemporaneously. Areas having abundant lava flows were probably proximal to eruptive centres and areas with abundant debris flows were situated in depressions off the flanks of the centres.

Felsic Metavolcanic Rocks (unit 3)

Volcanic rocks of this composition (i.e., colour index less than 10) occur as bands and lenses intercalated with intermediate and mafic volcanic rocks of the Upper Mixed Unit. A very distinctive horizon of these rocks extends from Chebucto Lake in the west to the east side of Zigzag Island and from there, the unit is folded back to the northeast side of Zigzag Island (*see* Map 2549, back pocket). The unit is exposed over a strike length of at least 10 km and is up to 400 m thick. Other, less extensive, lenticular, felsic volcanic horizons range from single outcrops to zones as much as 500 m in thickness and several kilometres in length.

The felsic volcanic rocks are predominately fragmental rocks. These rocks consist mostly of crystal to aphyric tuffs with subordinate lapilli tuffs and tuff breccias. In some of these rocks, the fragments are angular and consist of tuffaceous to pumiceous clasts of a composition similar to that of the groundmass. Crystals con-

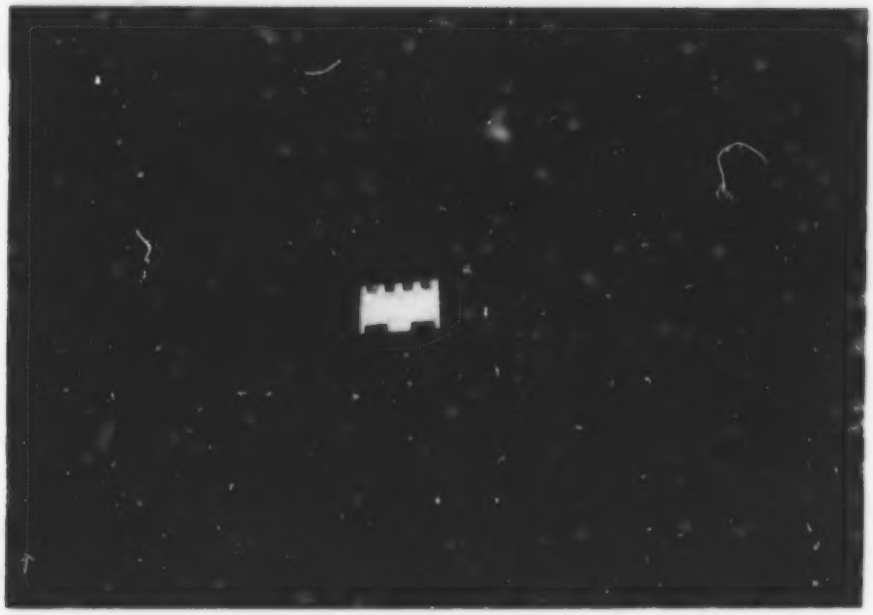


Photo 8. Massive felsic volcanic rock (flow, tuff or sill) with polygonal columnar joints. Outcrop on the south shore of Victoria Island.

sist of broken and angular quartz and feldspar (plagioclase with or without alkali feldspar). However, some of the felsic volcanic rocks are felsic varieties of debris flows. The clasts are subangular to subrounded lithic fragments which are heterolithic in composition, and in which crystals of plagioclase are more abundant than quartz.

In two localities, one on the southwest side of Victoria Island and the other on the east side of Cul De Sac Lake, in the southwest part of the map area, massive, fine-grained, plagioclase-porphyritic felsic bands contain well-preserved columnar jointing (Photo 8). On Victoria Island, the horizon having columnar jointing is 12 m thick. It is not certain if these felsic rocks are flows, tuffs, or sills.

A distinctive felsic horizon extends from Chebucto Lake to Zigzag Island (*see* Map 2549, back pocket). It can be distinguished from other felsic volcanic rocks in the map area in that quartz and alkali feldspar phenocrysts are abundant (in roughly subequal amounts up to a total of about 30 percent) and plagioclase phenocrysts are relatively minor (up to 5 percent). The southern part of this horizon is predominantly massive crystal tuff with some isolated localities where fine- to medium-grained pumiceous fragments or subtle banding features can be distinguished. The northern part of the unit is more distinctive, contains abundant coarse fragments, and locally, thinly bedded crystal tuffs with very fine-grained black cherty beds.

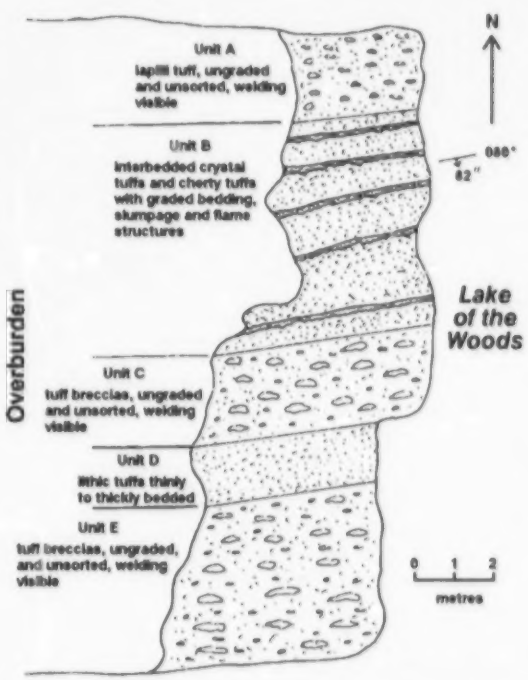


Figure 3. Sketch of ignimbrite outcrop on east side of Zigzag Island.

This transition is well exposed along the shoreline of the east side of Zigzag Island (Map 2549, back pocket). Here, the southernmost 100 m of the unit is a massive quartz-feldspar crystal tuff with locally exposed subtle layering. The northernmost 30 m of exposure consists of five texturally distinct layers from 2.3 m to 11.5 m thick (Figure 3). The layers range from tuff breccias to

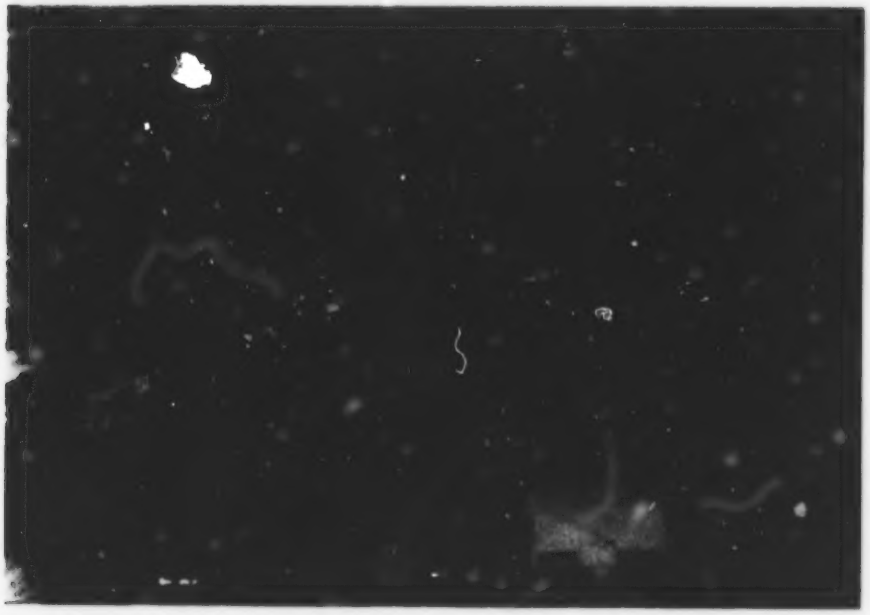


Photo 9. Felsic ignimbrite with interbedded tuff (grey) and very fine-grained cherty beds (black). Note the flame structures on one side of the cherty beds indicating facing direction is towards the top of the photo. Outcrop on the east side of Zigzag Island.

lapilli tuffs with one very distinctive layer 11.5 m thick consisting of alternations of normally graded crystal tuffs with thin beds (up to 10 cm thick) of very fine-grained black cherty tuff (Photo 9). Graded bedding and soft-sediment deformation consisting of flames and ball and pillow structures (Photo 9) at the base of sandy tuff beds indicate tops to the south.

PETROGRAPHY

Fragments from the felsic ignimbrite horizon on Zigzag Island consist predominately of aphyric to porphyritic pumice. These are distinguished by highly irregular shapes and locally by flattening with flame-like terminations suggesting incipient welding in some localities (Photo 10). Angular to subangular lithic or tuffaceous clasts are porphyritic to aphyric (Photo 10) and undeformed. Phenocrysts constitute up to about 30 percent of the rock. They consist of quartz (up to 15 percent), microcline (up to 15 percent) and plagioclase (up to 5 percent).

The matrix consists of very fine-grained anhedral granoblastic quartz and feldspar with subhedral lepidoblastic sericite with or without biotite, and accessory to trace amounts of carbonate and opaque minerals.

In the other felsic metavolcanic occurrences in the map area (and the areas mapped to the east, *see* Ayer et al. 1985; Ayer and Gil 1986), plagioclase crystals are more abundant (up to 50 percent). Quartz crystals may or may not be present in significant quantities, and microcline was not observed.

INTERPRETATION

The main felsic horizon from Chebucto Lake to Zigzag Island is interpreted to be pyroclastic in origin. The vertical succession of primary structures—tuffaceous base, an unbedded, ungraded mid-portion and bedded tuffaceous tops, the presence of pumice, monolithic composition, and development of stretching textures suggestive of welding—indicate the unit is a subaerially erupted ignimbrite comparable to other Archean occurrences (cf., Thurston 1980).

A subordinate amount of the felsic fragmental volcanic rocks may be felsic debris flows which are stratigraphically associated with the intermediate debris flows. These felsic debris flows tend to have less angular clasts and are heterolithic in composition. Phenocrysts of plagioclase predominate, with or without minor quartz, and alkali feldspar phenocrysts are absent.

A subaqueous environment is indicated for the felsic metavolcanic rocks of both pyroclastic and debris flow origin. However, it is possible that the pyroclastic horizon was subaerially erupted and deposited in a subaqueous environment on the flanks of the eruptive centre. A relatively shallow water environment is implied by their intercalation with highly vesicular pillowed flows.

Metasedimentary Rocks (unit 4)

Two stratigraphically distinct groups of sedimentary rocks occur in the map area. The sedimentary rocks of this unit (unit 4) are intercalated with volcanic rocks of the Upper Mixed Unit. Another sedimentary unit desig-

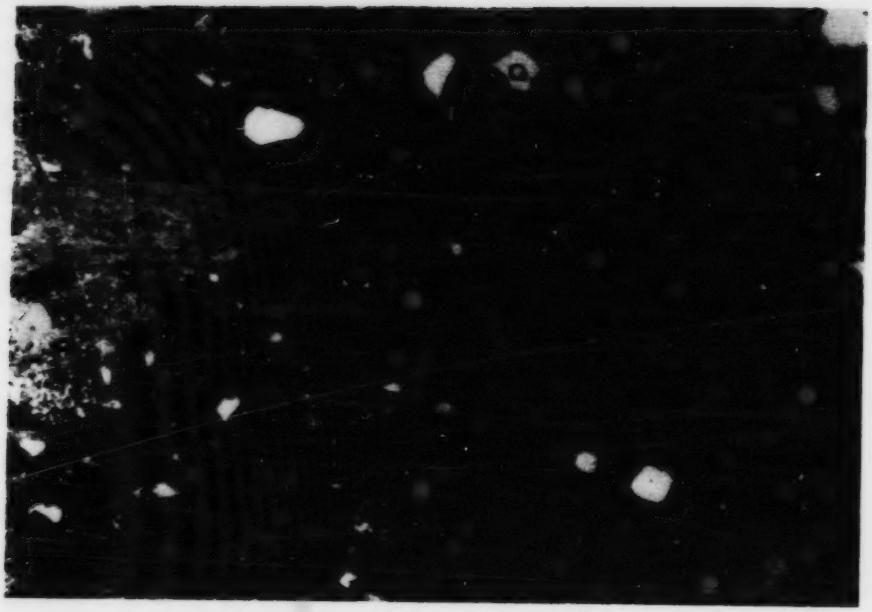


Photo 10. Photomicrograph of felsic tuff breccia with partly welded pumice (Pu), lithic clasts (L) and quartz crystals (Q). Note the euhedral outlines of phenocrysts (Ph) in fragments and the angular broken outlines of crystals in the matrix (Q). Crossed polars, field of view 10 mm. Sample 86 JAA 0633 from the east side of Zigzag Island.

nated the White Partridge Bay Group (unit 8) overlies the Upper Mixed Unit and is described later.

The sedimentary rocks within the Upper Mixed Unit occur as relatively small, isolated, lenticular horizons up to about 200 m wide and 2 km long. They are most abundant in the west-central part of the map area but also occur scattered throughout the Upper Mixed Unit.

The metasedimentary rocks predominantly consist of very thinly to thinly bedded (1 to 5 cm thick) siltstones and/or argillitic mudstones, locally with thin to thick interbeds (3 to 30 cm) of fine-grained felspathic wacke. The siltstones are siliceous and light grey on weathered surfaces and are commonly normally graded. On a small island in eastern Ptarmigan Bay, thin to thick bedded siltstones and wackes are cut by amygdaloidal mafic dikes and sills which are probably feeders to overlying mafic flows (Photo 11).

Minor exposures of iron formation occur in various locations within the Upper Mixed Unit. These rocks consist of sulphide-chert iron formation and in one locality, silicate-magnetite iron formation. These occurrences of iron formation are very limited in vertical and lateral extent, are typically restricted to single outcrops and are not traceable on aeromagnetic Map 1136G (ODM-GSC 1962).

The best exposure of sulphide iron formation is on the east side of a small island about 1 km northeast of Victoria Island. The sulphide-rich zone is about 10 m thick, but is highly folded and could not be traced to the west side of the island. Alternating pyrite-rich and thinly laminated chert beds range from 5 to 20 cm thick. Pyritic beds consist of up to 30 percent very fine-grained pyrite concentrated as spherical "concretions" up to 1 cm in diameter in a very fine-grained siliceous matrix. In the northern part of the outcrop, these change into interbedded chert and dark grey argillite locally with highly disrupted chert beds (Photo 12).

Silicate-magnetite iron formation occurs on the north side of a small island 1 km southeast of Mud Portage Channel. This iron formation occurs near the contact between a thick mafic sill to the south and interbedded siltstones and wackes to the north. It is about 5 m thick and is exposed over a strike length of about 10 m. The unit is fine grained and dark green. The unit consists of 75 percent very fine-grained amphibole (grunerite or actinolite) with 20 percent very fine-grained disseminated magnetite (with minor concentration in thin laminations up to 1 mm thick), 5 percent carbonate and traces of quartz.

PETROGRAPHY

Wackes typically consist of up to 80 percent fine-grained angular grains. These grains consist mainly of feldspar with minor quartz, in a very fine-grained matrix of felspathic silt with lepidoblastic chlorite and accessory to trace epidote, carbonate, sericite and opaque minerals. The siltstones consist of very fine-grained feldspathic silt with minor chlorite, sericite, epidote and opaque minerals.

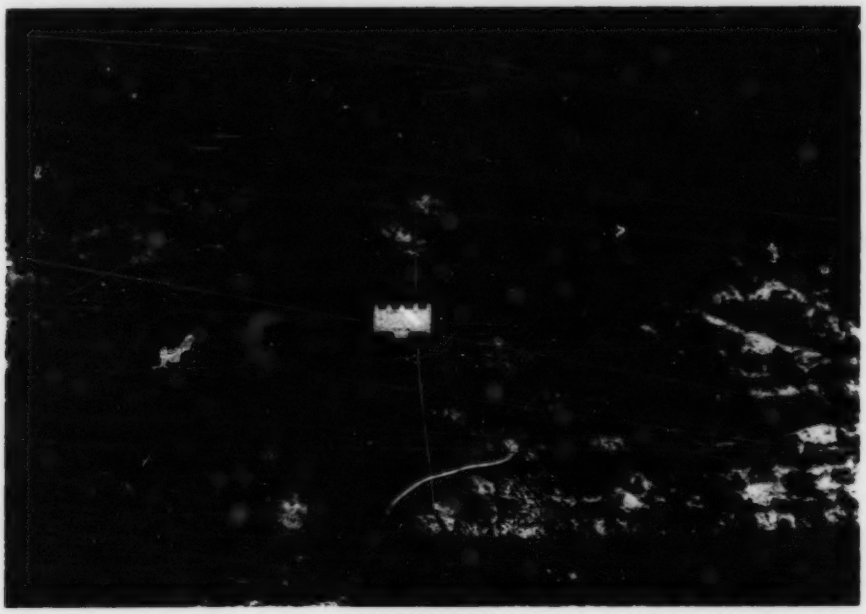


Photo 11. *Thinly to thickly bedded siltstones and feldspathic wackes cut by a mafic dike. Small island in eastern Ptarmigan Bay.*

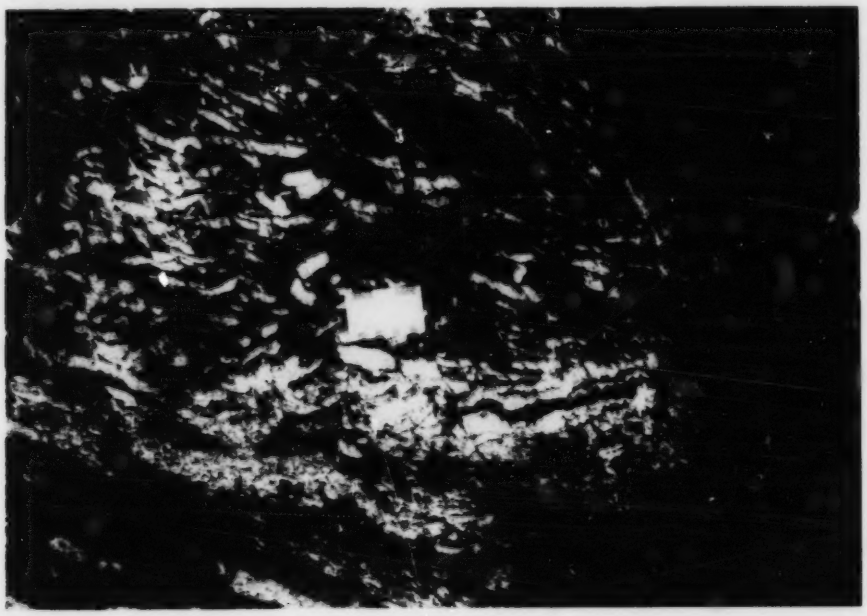


Photo 12. *Iron formation with interbedded chert and argillite and highly distrupted chert beds. East side of the small island 1 km northwest of Victoria Island.*

INTERPRETATION

The clastic sedimentary rocks of this unit are interpreted to be volcaniclastic interflow sedimentary rocks. These rocks may be the distal turbiditic equivalent of debris flows. Sedimentation probably occurred more or less simultaneously with volcanism; these rocks are thus intimately intercalated with the volcanic rocks.

The chemical sedimentary rocks are very restricted in lateral and vertical extent and are interpreted to have been very localized (ponded) exhalative sediments resulting from seafloor fumerolic emanations.

METAMORPHOSED ULTRAMAFIC AND MAFIC INTRUSIVE ROCKS (UNITS 5 AND 6)

Units 5 and 6 are described together because of their close genetic relationship. Mafic intrusions, however, also occur in undifferentiated intrusions or in differentiated sills in which no ultramafic phases occur.

The mafic intrusions are typically lenticular, range up to about 1 km in thickness and 10 km in length, and parallel the stratigraphy. These rocks intrude the Lower Mafic and Upper Mixed units, but not the overlying White Partridge Bay Group.

The ultramafic phases of the sills are relatively minor (less than 5 percent) and range up to about 60 m in thickness and 1 km in length. These rocks have been observed locally at the bases of differentiated sills, but also within the interior parts of some of the sills. This indicates the relatively complex composite nature of some of the differentiated sills. In a typical differentiation sequence, the base of a sill may consist of up to 20 m of peridotite, be overlain by a pyroxenitic unit up to 40 m thick, which is in turn overlain by a gabbroic upper portion up to several hundred metres thick. The gabbroic part may grade from melagabbro to leucogabbro or quartz diorite. Contacts between compositional variations are typically gradational over several metres.

Metaperidotite is fine to medium grained and has a knobby texture. The colour ranges from grey to dark grey-green on fresh surfaces, and orange-brown on weathered surfaces. These rocks are typically talcose and magnetic. Metapyroxenites are fine to medium grained, dark green on the fresh surface, and dark green to brown on weathered surfaces. Metapyroxenites differ from the metaperidotites in that they can contain up to 10 percent plagioclase and are typically nonmagnetic.

The classification of mafic intrusions is based on colour index (CI) and quartz content: with melagabbro from 90 to 60 (CI), gabbro from 60 to 30 (CI), and leucogabbro less than 30 (CI). Quartz gabbro and quartz diorite have a similar range of colour indices to gabbros and leucogabbro respectively, but contain more than 5 percent quartz. The mafic intrusive rocks may contain up to 10 percent magnetite and are thus highly magnetic. The mafic intrusive rocks are fine to medium grained, equigranular, and range from dark green to light grey-green on fresh and weathered surfaces.

PETROGRAPHY

Thin section examination of knobby peridotite revealed it consists of fine- to medium-grained, cumulate, anhedral serpentinized olivine (40 percent) and talcose pseudomorphs after pyroxene (orthopyroxene?) (20 percent), in an intergranular fine-grained groundmass of subhedral chloritized clinopyroxene(?) (20 percent) with minor amphibole (5 percent) and magnetite (5 percent).

The mafic intrusive rocks contain subhedral, granular to subophitic intergrowths of pyroxene (altered to amphibole or chlorite) and plagioclase (altered to epidote ± chlorite ± carbonate) with accessory to trace magnetite, with or without quartz and apatite.

A thin section from the upper part of a differentiated sill on the northeast side of Ogema Bay is medium-grained, subhedral, granular quartz diorite. The rock is unusual in that it contains about 5 percent fine- to medium-grained anhedral microcline. It also contains unaltered subhedral plagioclase (60 percent) of oligoclase composition (An_{21}), chloritized and epidotized subhedral amphibole (20 percent), subhedral magnetite (10 percent), anhedral quartz (5 percent) and euhedral apatite (trace).

Another thin section from the leucocratic part of a differentiated sill about 1 km southwest of Victoria Island is granophyric quartz diorite. The rock consists of fine-grained unaltered subhedral oligoclase (An_{20}) laths (60 percent) having fine- to medium-grained intergranular granophyric intergrowths of quartz and feldspar (20 percent), anhedral quartz (10 percent), chloritized and epidotized subhedral amphibole (10 percent), and opaque minerals (trace).

METAMORPHOSED FELSIC TO INTERMEDIATE INTRUSIVE ROCKS (UNIT 7)

Rocks of this unit form dikes, sills and small stocks interpreted to be of synvolcanic origin that may also include intrusions related to later granitic intrusions (units 9 and 10).

Two relatively large intrusions of this unit occur in the northeast part of the map area. One is an irregular stock about 1.5 km long intruded at the contact between the Lower Mafic and Upper Mixed units at Hinterland Lake, in the northeast corner of the map area. The other is a sill up to 300 m thick and 2.5 km long west of Inglis Lake.

Rocks of this unit are commonly porphyritic and consist of plagioclase with or without quartz and amphibole phenocrysts in a fine- to very fine-grained groundmass. Locally, the rocks are fine-grained aphyric felsite. Compositions range from felsic to intermediate.

WHITE PARTRIDGE BAY GROUP METASEDIMENTARY ROCKS (UNIT 8)

This unit occurs in the eastern part of Clearwater Bay, mainly on the northern part of Corkscrew Island (Map 2549, back pocket). Only the lowermost part of the unit is exposed in the map area.

A thicker stratigraphic succession up to 1.5 km thick is preserved east of the map area, north of White Partridge Bay (Ayer and Gil 1986). In the White Partridge Bay area, the group consists of a coarsening upwards succession with mudstones and fine-grained distal submarine wackes at the base. These change to interbedded, massive to cross-bedded sandstones and congomerates of possible fluviatile origin in the upper part of the group (Ayer 1987).

Within the map area, only the lower part of the group is exposed. It consists predominantly of mudstone, siltstone and fine-grained wackes. Bedding ranges from 1 to 30 cm in thickness. Normal grading and soft-sediment structures, such as slump folding and flame structures, are common.

Locally, the basal parts of the group consist of fine-grained, massive to thickly bedded quartz wackes or crystal tuffs with local interbeds of thinly bedded siltstone and/or mudstone.

Beds of normally graded, turbiditic, fine-grained conglomerate up to 1 m thick are interbedded with turbidites. The conglomerates are most abundant along the north shore of Corkscrew Island. These rocks contain angular mudstone rip-ups with wacke and minor volcanic clasts (Photo 13). In some, erosional bases are evident which truncate the underlying beds at a low angle.

INTERPRETATION

The sedimentary rocks of the White Partridge Bay Group were interpreted as a Timiskaming equivalent unit by Thomson (1937). Evidence bearing on this interpretation is summarized below. Most Timiskaming equivalent successions consist of calc-alkalic to alkalic volcanic rocks which emanated from largely subaerial strato-volcanoes having laterally equivalent volcaniclastic debris flows and fluviatile sedimentary rocks (Ayres and Thurston 1985). These sequences include extensive fluviatile sedimentary rocks and in the late stages of the type area and elsewhere are seen to be deposited prior to the second deformation (Corfu and Stott 1986). The White Partridge Bay Group fits this model in that:

1. Heterolithic conglomerates with rounded syntectonic granitoid clasts occur intercalated with cross-bedded fluviatile sandstones.
2. There is a lack of pretectonic mafic intrusive rocks and synvolcanic porphyry sills cutting the group.
3. On the west side of Corkscrew Island, an east-northeast-trending mafic sill is truncated by White Partridge Bay Group sedimentary rocks. This can be interpreted to be either an erosional unconformity or a tectonic event.
4. The group may be correlative on lithologic grounds with the Crowduck Lake Group (Davies 1965) which has a well-exposed unconformable relationship to underlying Keewatin strata.

These observations suggest the White Partridge Bay Group unconformably overlies the Keewatin strata and that the group postdates both synvolcanic intrusive rocks of the Keewatin and early granitoid activity.

PRETECTONIC TO SYNTECTONIC FELSIC TO INTERMEDIATE INTRUSIVE ROCKS (UNIT 9)

Intrusive rocks included in this unit range from pre- to syntectonic. Pretectonic intrusive rocks include those of the Winnipeg River Subprovince in the north, and in the west the Winnetka Lake stock and the Ridge Lake stock. The Granite Lake stock is considered to be syntectonic.

Winnipeg River Subprovince

Rocks of the Winnipeg River Subprovince occur in a broad band across the northern part of the map area. In the northeast, these rocks are in abrupt, possibly unconformable (Clark et al. 1981; Beakhouse 1985) or tectonic, contact with Lower Mafic Unit volcanic rocks of the Wabigoon Subprovince. On the southeast side of War Eagle Lake (Map 2549, back pocket) a marginal band of alkali feldspar megacrystic granodiorite is up to several

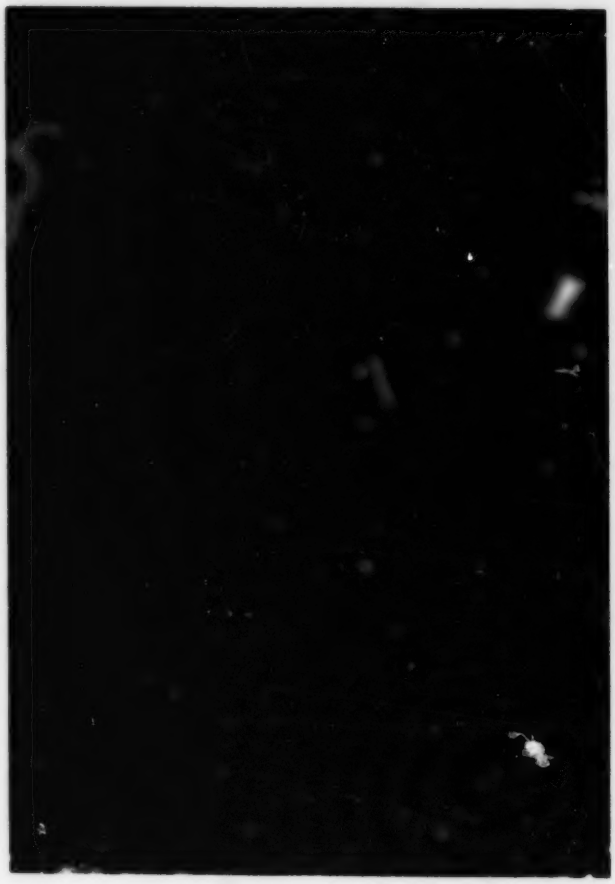


Photo 13. Interbedded turbiditic conglomerates and thinly to thickly bedded wackes. Normal grading and flame structures indicate facing direction is towards the top of the photograph. Outcrop on the north side of Corkscrew Island.

TABLE 2. ESTIMATED MODAL MINERALOGY OF METAMORPHOSED FELSIC TO INTERMEDIATE INTRUSIVE ROCKS (UNIT 9), CLEARWATER BAY AREA.

	Winnipeg River Subprovince		Winnetka Lake Stock				Ridge Lake Stock		Granite Lake Stock
Rock type	gneissic granodiorite	megacrystic granodiorite	hornblende granodiorite	hornblende-quartz monzodiorite	hornblende diorite	hornblende diorite	biotite-quartz monzodiorite	megacrystic granodiorite	megacrystic granodiorite
Sample No.	103	112	438	468	414a	415	462	163	405
plagioclase	45	50	55	55	55	55	65	45	50
(composition)	An_{29}	An_{23}	An_{35-25}		An_{24}		An_{34-28}	An_{28}	An_{28}
quartz	25	20	10	10	5	3	10	30	25
microcline	20	20	20	15	tr	2	10	20	20
biotite	7	10	5	5	5		10	4	5
amphibole			10	15	35	35		tr	
muscovite	2	tr							
chlorite						5			
epidote	1	tr	tr	tr		tr	5	1	tr
sphene			tr	1	tr	tr	tr		tr
apatite		tr	tr	tr		tr	tr	tr	tr
opaques			tr			tr	tr		

hundred metres wide. The unit has an abrupt contact with volcanic rocks to the south and grades into gneisses to the north. This unit is reportedly continuous for over 30 km to the northeast and has been tentatively dated at 2605^{+9}_{-7} Ma in the Keewatin area (Beakhouse 1985). This unit consists of subhedral to euhedral alkali feldspar phenocrysts up to 3 cm in size in a medium-grained, strongly foliated groundmass (Table 2, sample 112). West of War Eagle Lake, the contact between the Winnipeg River and Wabigoon subprovinces is a zone of hybridization and brecciation. The metavolcanic rocks are cut by dikes of granitic phases and some assimilation has occurred. This suggests an intrusive contact at this locality. Amphibolite inclusions up to 5 m wide occur throughout the gneisses. These inclusions are most probably inclusions of unassimilated mafic metavolcanic rocks.

The gneisses range from biotite tonalite to biotite granodiorite (Table 2, sample 103). Gneissosity is defined by alternating plagioclase-rich and amphibole-rich bands 1 to 10 cm wide.

Winnetka Lake Stock

This stock was intruded into the Wabigoon Subprovince volcanic rocks in the northwestern part of the map area. The stock grades into orthogneisses of the Winnipeg River Subprovince north of the south side of Deception Lake and east of Rice Lake (Map 2549, back pocket). To the south, the stock displays intrusive contacts with dikes of granodiorite intruding into mafic metavolcanic rocks of the Lower Mafic Unit.

The composition of the stock ranges from quartz monzodiorite to granodiorite with hornblende greater than biotite (Table 2, samples 438 and 468). Typically, the stock is medium to coarse grained and equigranular. A well-developed penetrative foliation is steeply dipping and is parallel to the regional foliation. The foliation passes from the volcanic rocks into the stock and inclusions without deviation. This supports the conclusion of Vagt (1968) that the foliation is of tectonic origin and that the intrusion was emplaced prior to tectonism.

An unusual phase of the stock occurs north of Rice Lake (Map 2549, back pocket). It is lenticular in shape, about 1 km wide and 2 km long, and is parallel to the regional foliation. It consists of coarse-grained hornblende diorite. The diorite contains coarse-grained, euhedral plagioclase laths (up to 2 cm in length) with subhedral intergranular hornblende (up to 1 cm) and minor fine-grained biotite, quartz and microcline (Table 2, samples 414a and 415). Also present within the diorite are inclusions of hornblendite up to 10 m wide, consisting of up to 95 percent hornblende with minor plagioclase.

Ridge Lake Stock

A small stock extends from the west side of Granite Lake to Ridge Lake on the western margin of the map area (Map 2549, pocket). It is exposed over a length of about 1 km and is up to 1.5 km wide along the west side of Granite Lake. The contact between this stock and the Granite Lake stock lies under Granite Lake.

The Ridge Lake stock ranges in composition from biotite granodiorite to hornblende diorite to plagioclase-porphyritic biotite-quartz monzodiorite (Table 2, sample 462). Strongly hybridized zones of partial melting and intrusive breccias are common. Inclusions and associated intrusive phases have well-developed penetrative foliations and locally, granitic dikes are tightly

folded. These features indicate the stock is of pretectonic origin.

Compositionally the Ridge Lake stock is very similar to the Winnetka Lake stock. Both stocks are pretectonic and occur in close proximity to each other. It is therefore possible that the Ridge Lake stock may be an apophysis of the Winnetka Lake stock.

Granite Lake Stock

This oval stock occurs totally within the Wabigoon metavolcanic rocks and is separated by a thin septum of mafic metavolcanic rocks from the Winnetka Lake stock situated to the north and west of Rice Lake (Map 2549, back pocket). The stock is about 5 km long and 3 km wide with its long axis oriented east-northeast.

The Granite Lake stock consists of homogeneous, alkali feldspar megacrystic granodiorite. Subhedral to euhedral microcline phenocrysts up to 3 cm in size occur within a medium-grained, equigranular, subhedral granular groundmass of plagioclase, quartz, microcline and biotite (Table 2, samples 163 and 405). A weakly developed penetrative foliation follows the contacts of the intrusion and is not well developed in the interior.

In the south, the intrusion is equigranular from the contact to about 500 m from the contact, before the alkali feldspar megacrysts are well developed. A thin septum of amphibolitized mafic volcanic rocks wrap around the north part of the intrusion. Foliations in the volcanic rocks north and south of the intrusion parallel the contacts, and rare inclusions within the intrusion are oriented east-west. These features would suggest the intrusion was emplaced syntectonically rather than pretectonically as was suggested by Vagt (1968). It also appears in overall map pattern to have intruded and truncated the Ridge Lake stock, which is a pretectonic intrusion exposed on the west side of Granite Lake.

SYNTECTONIC TO LATE TECTONIC FELSIC INTRUSIVE ROCKS (UNIT 10)

Intrusions of this unit include the syntectonic Rush Bay stock and late tectonic Canoe Lake stock.

Rush Bay Stock

This lensoidal intrusion is oriented east-northeast. The stock is 3 km long (to the western margin of the map area) and up to 1 km wide. It occurs within the Crowduck Lake–Witch Bay shear zone.

The stock consists predominantly of quartz monzodiorite with medium- to coarse-grained euhedral plagioclase and minor microcline phenocrysts (up to 1 cm in size) set in a fine-grained groundmass (Table 3, sample 748). Locally, a rapakivi texture is developed with microline phenocrysts mantled by plagioclase (Photo 14). This texture is preserved in the core of the intrusion but is obliterated towards the margins by a strong mylonitization, which has resulted in augen-shaped phenocrysts in a highly schistose and carbonatized groundmass.

TABLE 3. ESTIMATED MODAL MINERALOGY OF SYNTECTONIC TO LATE TECTONIC FELSIC INTRUSIVE ROCKS (UNIT 10) CLEARWATER BAY AREA.

	Rush Bay Stock	Canoe Lake Stock	
Rock type	plagioclase-potassium feldspar porphyry	plagioclase-quartz porphyritic tonalite	tonalite
Sample No.	748	483	700
plagioclase	55	70	65
quartz	10	25	30
microcline	22		
biotite	8		3
amphibole		5	2
apatite	tr		tr
titanite		tr	tr
sericite	tr	tr	tr
carbonate	tr	tr	
opaque minerals	tr	tr	tr
chlorite		tr	tr
epidote	tr	tr	tr

Fine-grained aphyric felsite is gradational into the porphyritic phase at the southern and western margins of the stock.

Plagioclase and alkali feldspar porphyry dikes and aphyric felsite dikes, related to the Rush Bay stock, cut the volcanic rocks southwest of the stock.

Canoe Lake Stock

This oval intrusion is about 11 km long and 6 km wide and is oriented with its long axis towards the northeast. Only the northeastern part, about one quarter of the intrusion, occurs in the southwestern part of the map area. The intrusion was comprehensively studied by Campbell (1973). Campbell has characterized the stock as follows:

> The Canoe Lake stock is a massive, homogeneous, single phase quartz diorite intrusion. *[Note: according to Streckeisen's (1975) classification it is a tonalite; Campbell used a classification scheme by Bateman (1961) which does not discriminate the quartz diorite field from those of tonalites and trondhjemites.]*
>
> Its texture is medium grained, hypidiomorphic granular, and ranges from equigranular to seriate porphyritic with large quartz eyes scattered through the rock. The quartz diorite ranges from light red and grey-red to grey and grey-green. Concentrations of quartz eyes and colour differences are irregular across the intrusive body. The pre-alteration mineral composition was 45 to 70 percent plagioclase (andesine), 15 to 50 percent quartz, as much as 15 percent hornblende, and a maximum of 15 percent biotite. Minor accessory minerals include rutile, sphene, apatite and traces of magnetite and ilmenite. Minor hematite is commonly present as stringers crosscutting grains or surrounding grain boundaries.

Samples of equigranular and porphyritic tonalite were studied in thin section (Table 3, samples 700 and 483, respectively). The intrusion is transected by late dikes of quartz-feldspar porphyry, feldspar porphyry, fine-grained equigranular tonalite and felsite, which also occur in the surrounding country rock.

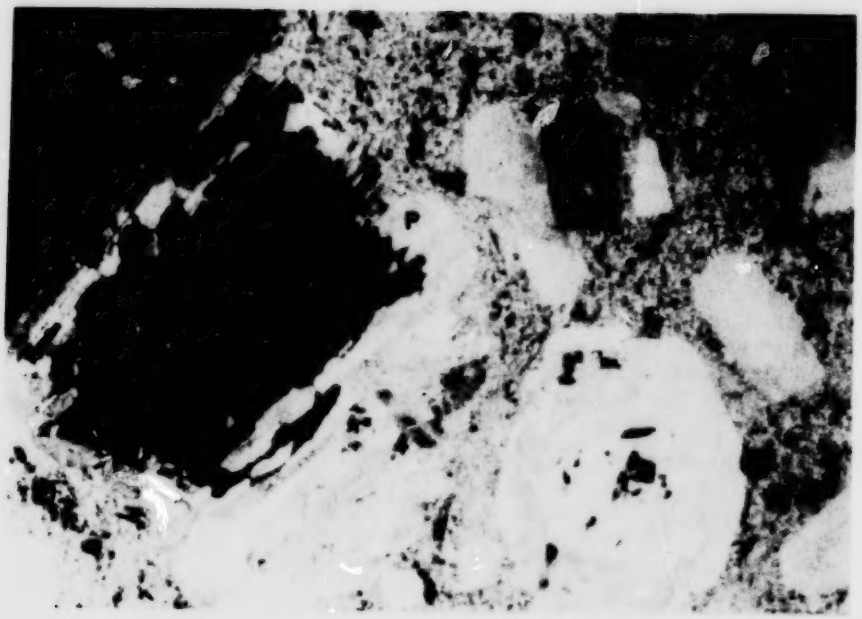


Photo 14. *Photomicrograph of rapikivi-textured porphyritic quartz monzodiorite from the Rush Bay stock. Note the alkali feldspar phenocryst core (A) mantled by fine-grained plagioclase (P). Crossed polars; field of view 10 mm. Sample 86 JAA 0748 from Rush Bay.*

Photo 15. *Lamprophyre dike containing rounded granitic and mafic inclusions cutting deformed pillowed metavolcanic rocks (right side of photo). Outcrop on the northwest side of a small island 1 km east of Victoria Island. Hammer handle is 40 cm long.*

Contacts with the surrounding rocks, where visible, are intrusive and show brecciation, "diking" and hybridization of the country rock. The centre of the intrusion is relatively unstrained; the effects of cataclastic strain increase towards the margins of the stock. The surrounding rocks contain a foliation which is roughly parallel to the contacts and which dips steeply away from the stock.

Hydrothermal alteration is pervasive and has varying degrees of chloritization, carbonatization, epidotization and silification visible on a macroscopic scale.

The Canoe Lake stock is interpreted to be a shallow, late tectonic pluton. The high degree of fracturing and copper-molybdenum-zinc mineralization indicate that the body is an epizonal intrusion. The marginal cataclastic foliations and absence of a penetrative regional foliation in the stock suggest late tectonic emplacement; the central part of the body remained mobile during emplacement (Campbell 1973).

MAFIC INTRUSIVE ROCKS (UNIT 11)

Small lamprophyre dikes were observed in several locations in the southern half of the map area. An unusual lamprophyre dike occurs in a small island about 1 km east of Victoria Island. It is about 2 m wide and contains rounded granitic to mafic inclusions (Photo 15). A northwest-trending lamprophyre dike in the south-central part of Ogema Bay was examined in thin section. It is a medium-grained, subhedral granular kersantite lampyrophyre with 50 percent subhedral plagioclase (unaltered andesine, An_{30}), 30 percent subhedral biotite, 18 percent euhedral to subhedral carbonate (which appears to be a primary magmatic component), 2 percent euhedral magnetite and traces of pyrite and apatite.

PROTEROZOIC

MAFIC INTRUSIVE ROCKS (UNIT 12)

A single large diabase dike trends northwest across the northeastern part of the map area. The diabase belongs to a group of dikes referred to as the Kenora–Kabetogoma diabase swarm dated at about 2.1 Ga (Halls 1982, 1986).

The dike is locally discontinuous and displaced in numerous small sinistral offsets. A major gap of 3 km occurs between Highway 17 (where the dike has been reduced to several small parallel dikes up to 1 m thick) and the northwest side of Boyne Lake, where the dike was again observed and is as much as 100 m thick.

The dike and surrounding country rock are commonly epidotized for up to 10 m from the contact.

CENOZOIC

QUATERNARY

Pleistocene

Unconsolidated sediments were deposited during various glacial stages in the Pleistocene. The last stage was the Wisconsinan stage (about 12 000 years BP). The deposits consist predominantly of unsorted till deposited in depressions between outcrop ridges. Stratified outwash deposits were observed in a few gravel pits in the north. These consist of thin to thickly bedded sand and gravel beds with locally developed cross-bedding.

Abundant glacial striations were observed on shoreline outcrops and are consistently oriented towards the southwest.

During the retreat of the Wisconsinan sheet, glacial Lake Agassiz formed and fine-grained material was washed from topographic highs, leaving bare outcrops and localized clay deposits in the depressions. Clay derived from Lake Agassiz is found in mud along the shoreline of Lake of the Woods.

Recent

Stream and lake deposits of sand, silt, clay and organic material are presently being formed and concentrated on lake bottoms. Swamps and muskegs with organic deposits are scattered throughout the map area.

Aeromagnetic Data

Comparison of the geology of the Clearwater Bay area (Map 2549, back pocket) with the 1 inch to 1 mile (1:63 360) aeromagnetic map for the area, Map 1136G (ODM-GSC 1962), shows a relatively good large-scale correlation between major units and aeromagnetic data.

Magnetic highs of up to about 61 000 gammas are associated with the large, differentiated mafic to ultramafic sills in the south.

Moderate magnetic highs of up to 60 700 gammas are associated with the Lower Mafic Unit in the north.

Rocks of the Upper Mixed Unit are moderately magnetic, ranging in intensity from about 60 400 to 60 600 gammas. Localized highs can be correlated with mafic to ultramafic intrusions.

The sedimentary rocks of the White Partridge Bay Group are low in magnetic intensity, with values less than 60 500 gammas, and have very flat contour patterns.

The large granitic bodies are low to moderate in magnetic intensity, with values ranging from 60 300 to 60 600 gammas, and relatively flat contour patterns.

Petrochemistry

Thirty-four samples were chemically analyzed for major oxides and selected trace and rare earth elements (REE) by the Geoscience Laboratories Section of the Ontario Geological Survey. Results are presented in Table 4 with corresponding sample descriptions in Table 5 and the sample locations on Figure 4.

Five of the analyses are of metabasalt from the Lower Mafic Unit (sample numbers 168, 358, 359, 600 and 756). Eighteen samples are of metavolcanic rocks of the Upper Mixed Unit: These include five basalts (sample numbers 37, 38, 75, 172, 331 and 335); eight intermediate metavolcanic rocks, which range from basaltic-an-

TABLE 4. CHEMICAL ANALYSIS OF SAMPLES FROM THE CLEARWATER BAY AREA.

MAJOR OXIDES

	86JAA-0020	86JAA-0027	86JAA-0037	86JAA-0038	86JAA-0075	86JAA-0142
SiO_2 (wt%)	54.40	60.70	49.30	49.00	48.80	59.00
TiO_2	1.23	0.64	1.25	2.36	0.67	0.65
Al_2O_3	16.90	16.20	16.00	14.60	15.80	16.10
Fe_2O_3	8.13	6.04	15.00	15.10	11.50	6.23
FeO	00.00	00.00	00.00	00.00	00.00	00.00
MnO	0.13	0.06	0.15	0.17	0.16	0.07
MgO	3.52	4.00	5.48	5.21	8.00	4.33
CaO	8.09	5.32	6.62	6.73	9.78	5.66
Na_2O	4.26	3.00	1.00	2.57	00.00	3.30
K_2O	0.14	1.15	00.00	0.07	00.00	1.93
P_2O_5	0.14	0.21	0.09	0.33	0.05	0.31
CO_2	1.10	0.07	1.04	0.18	1.01	0.57
S	0.11	0.01	0.05	0.07	0.12	0.01
H_2O^+	00.00	00.00	00.00	00.00	00.00	00.00
H_2O^-	00.00	00.00	00.00	00.00	00.00	00.00
LOI	2.40	1.80	4.60	2.90	4.70	1.70
total	99.30	99.10	99.50	99.00	99.40	99.30
sg	2.85	2.79	2.93	2.94	3.01	2.83

TRACE ELEMENTS*

	86JAA-0020	86JAA-0027	86JAA-0037	86JAA-0038	86JAA-0075	86JAA-0142
Ag (ppm)	-2	-2	-2	-2	-2	-2
Co	34	22	45	44	49	23
Cr	104	148	229	114	391	149
Cu	66	24	95	80	117	50
Ni	39	66	130	64	145	67
Pb	-10	-10	-10	-10	-10	-10
Zn	80	55	122	148	74	69
Nb	5	-5	-5	12	-5	-5
Rb	7	29	-5	-5	-5	24
Sr	169	636	182	433	107	916
Y	25	16	27	43	22	17
Zr	130	182	92	203	64	186
Th	10	-10	-10	-10	10	19
Pr	4.3	7	1.8	6.1	830 ppb	9.3
Sm	3.5	4.2	2.5	5.9	1.5	6
Eu	1.1	1.2	940 ppb	1.9	540 ppb	1.6
Gd	3.9	3.1	3.4	6	2	4.2
Tb	600 ppb	410 ppb	530 ppb	960 ppb	370 ppb	490 ppb
Dy	3.6	2.2	3.7	5.8	2.4	2.5
Ho	690 ppb	380 ppb	740 ppb	1.2	530 ppb	420 ppb
Er	2.2	1.1	2.3	3.3	1.7	1.2
Tm	310 ppb	140 ppb	320 ppb	460 ppb	220 ppb	150 ppb
Yb	1.7	980 ppb	1.9	2.8	1.5	1
Lu	280 ppb	150 ppb	300 ppb	420 ppb	230 ppb	140 ppb
Au	20 ppb	-2 ppb	-2 ppb	-2 ppb	-2 ppb	-2 ppb
Pt	-1 ppb	-1 ppb	-1 ppb	-1 ppb	11 ppb	-1 ppb
Pd	-1 ppb	-1 ppb	-1 ppb	-1 ppb	14 ppb	-1 ppb
Ce	32	56	12	42	5.2	75
La	15	25	4.9	17	2	35
Nd	16	24	8.5	26	4.5	35
Y	15	8.7	15	24	11	9.2

TABLE 4. CONTINUED.

MAJOR OXIDES

	86JAA-0168	86JAA-0172	86JAA-0310	86JAA-0331	86JAA-0335	86JAA-0349
SiO_2 (wt%)	47.10	50.90	47.70	49.00	49.40	42.10
TiO_2	0.50	2.48	3.65	1.38	1.23	0.30
Al_2O_3	17.80	15.00	11.60	15.00	15.00	5.35
Fe_2O_3	10.40	13.80	16.30	13.10	13.50	13.00
FeO	00.00	00.00	00.00	00.00	00.00	00.00
MnO	0.15	0.22	0.21	0.20	0.21	0.12
MgO	9.39	3.13	5.82	5.36	4.45	27.70
CaO	10.70	8.88	9.74	8.28	9.61	3.06
Na_2O	1.42	3.49	1.90	2.35	1.23	00.00
K_2O	0.17	0.24	0.14	0.92	0.11	0.01
P_2O_5	0.04	0.24	0.21	0.15	0.11	00.00
CO_2	0.08	1.12	0.25	1.20	1.56	0.78
S	0.05	0.07	0.14	0.13	0.11	0.03
H_2O^+	00.00	00.00	00.00	00.00	00.00	00.00
H_2O^-	00.00	00.00	00.00	00.00	00.00	00.00
LOI	1.70	1.00	1.60	2.90	3.80	8.30
total	99.40	99.40	98.90	98.60	98.70	99.90
sg	2.98	2.95	3.09	2.96	2.97	2.82

TRACE ELEMENTS*

	86JAA-0168	86JAA-0172	86JAA-0310	86JAA-0331	86JAA-0335	86JAA-0349
Ag (ppm)	-2	-2	-2	-2	-2	-2
Co	49	56	36	41	41	90
Cr	369	122	-10	163	192	1410
Cu	93	67	24	96	79	22
Ni	184	74	-5	59	91	865
Pb	-10	-10	-10	15	-10	-10
Zn	73	120	108	102	130	42
Nb	-5	13	13	-5	-5	-5
Rb	5	-5	-5	25	-5	-5
Sr	103	337	170	321	248	18
Y	17	31	34	29	29	12
Zr	56	181	147	124	107	31
Th	-10	-10	-10	-10	-10	-10
Pr	690 ppb	4.5	4.3	3.9	2.7	320 ppb
Sm	1.1	5.4	4.6	4.1	3.2	460 ppb
Eu	480 ppb	1.8	1.5	1.4	1.1	130 ppb
Gd	1.6	5.6	5.1	4.3	3.6	710 ppb
Tb	310 ppb	910 ppb	800 ppb	700 ppb	630 ppb	130 ppb
Dy	2	4.9	4.6	4.3	4	930 ppb
Ho	450 ppb	1	930 ppb	880 ppb	830 ppb	210 ppb
Er	1.4	2.6	2.6	2.4	2.3	650 ppb
Tm	190 ppb	340 ppb	340 ppb	320 ppb	300 ppb	80 ppb
Yb	1.4	2.2	2	2.1	2.2	700 ppb
Lu	220 ppb	310 ppb	310 ppb	300 ppb	300 ppb	100 ppb
Au	-2 ppb	-2 ppb	-2 ppb	-2 ppb	-2 ppb	2 ppb
Pt	7 ppb	-1 ppb	-1 ppb	-1 ppb	-1 ppb	3 ppb
Pd	6 ppb	-1 ppb	-1 ppb	-1 ppb	-1 ppb	2 ppb
Ce	3.7	29	30	26	19	2.1
La	1.2	11	12	9.8	7.1	790 ppb
Nd	3.1	20	18	16	11	1.4
Y	9.4	19	19	17	17	3.9

desite to andesite (sample numbers 20, 142, 371, 377, 629, 630, 753 and 755); and four rhyolites (sample numbers 380, 631, 632 and 634).

Four of the analyses are from synvolcanic intrusions. These include peridotite from a differentiated sill (sample number 349), a gabbro (sample number 310), a leucogabbro (sample number 609), and plagioclase porphyry (sample number 27).

Seven analyses are of various granitic intrusions from the map area. Three are from the Winnetka Lake stock (sample number 468 is a composite of the samples collected along highway 17 south of Caribou Lake, and sample numbers 414 and 415 are from a dioritic phase of the stock north of Rice Lake). One analysis is from the Ridge Lake stock (sample number 462). Another analysis is from the Granite Lake stock (sample number 405); two are from the Rush Bay stock: sample number 748 is of porphyry from the central part of the stock, and sample number 627 is of felsite from the south margin of the stock.

TABLE 4. CONTINUED.

MAJOR OXIDES	86JAA-0358	86JAA-0359	86JAA-0371	86JAA-0377	86JAA-0380	86JAA-0405
SiO_2 (wt%)	52.70	49.90	57.20	54.70	76.10	70.50
TiO_2	0.56	0.60	0.71	1.29	0.10	0.11
Al_2O_3	14.00	13.30	15.60	17.20	12.70	16.20
Fe_2O_3	10.20	11.90	9.39	9.04	1.71	1.26
FeO	00.00	00.00	00.00	00.00	00.00	00.00
MnO	0.12	0.15	0.14	0.11	0.01	00.00
MgO	8.20	8.54	4.66	5.30	0.55	0.59
CaO	7.44	9.12	3.69	3.33	0.22	2.18
Na_2O	3.28	2.97	3.00	3.80	2.80	5.02
K_2O	0.06	0.03	2.94	1.53	4.97	2.64
P_2O_5	0.04	0.04	0.16	0.24	0.01	0.04
CO_2	0.32	0.27	0.19	0.13	0.19	0.14
S	0.01	0.01	0.01	0.01	0.01	0.01
H_2O^+	00.00	00.00	00.00	00.00	00.00	00.00
H_2O^-	00.00	00.00	00.00	00.00	00.00	00.00
LOI	2.10	1.90	2.20	2.60	0.50	0.50
total	98.70	98.50	99.70	99.10	99.60	99.00
sg	2.92	2.98	2.81	2.77	2.63	2.65

TRACE ELEMENTS*	86JAA-0358	86JAA-0359	86JAA-0371	86JAA-0377	86JAA-0380	86JAA-0405
Ag (ppm)	-2	-2	-2	-2	-2	-2
Co	37	44	26	30	-5	-5
Cr	395	390	187	113	-10	12
Cu	40	91	30	11	-5	5
Ni	68	75	91	70	-5	8
Pb	-10	595	22	22	32	32
Zn	46	64	109	96	17	32
Nb	-5	-5	6	10	20	-5
Rb	-5	-5	117	43	116	85
Sr	70	101	170	209	47	539
Y	17	19	30	29	59	5
Zr	56	63	152	190	124	122
Th	-10	-10	15	-10	20	-10
Pr	930 ppb	840 ppb	6.2	6.3	8.6	
Sm	1.3	1.3	4.8	5.1	9.4	
Eu	480 ppb	430 ppb	1.3	1.5	290 ppb	
Gd	1.8	1.7	4.4	4.5	10	
Tb	320 ppb	310 ppb	740 ppb	750 ppb	1.5	
Dy	2.3	2.1	4.7	4.2	9.5	
Ho	520 ppb	490 ppb	1.1	900 ppb	2	
Er	1.5	1.6	3	2.3	5.4	
Tm	210 ppb	220 ppb	440 ppb	320 ppb	810 ppb	
Yb	1.6	1.6	3	2.1	5	
Lu	250 ppb	240 ppb	450 ppb	290 ppb	760 ppb	
Au	-2 ppb	-2 ppb	2 ppb	-2 ppb	-2 ppb	-2 ppb
Pt	8 ppb	7 ppb	2 ppb	2 ppb	-1 ppb	-1 ppb
Pd	8 ppb	5 ppb	-1 ppb	-1 ppb	-1 ppb	-1 ppb
Ce	6.4	6.1	49	51	59	
La	2.9	2.7	22	22	23	
Nd	3.9	3.7	22	22	33	
Y	9.5	9.3	21	20	50	

VOLCANIC GEOCHEMISTRY

A plot of SiO_2 (versus) $Na_2O + K_2O$ for volcanic rocks and synvolcanic intrusive rocks is shown on Figure 5. The figure demonstrates the subalkalic nature of these rocks and the variation in SiO_2 values indicating a range of compositions from basalt to rhyolite for the volcanic rocks. A substantial gap in SiO_2 values occurs from about 61 to 75 percent SiO_2. A similar feature was also observed in the volcanic rocks from the Rat Portage Bay area, although there the SiO_2 gap is smaller, from about 67 percent to 72 percent SiO_2 (Ayer 1987).

LOWER MAFIC UNIT

Analyses of Lower Mafic Unit volcanic rocks are all of basaltic composition (anhydrous $SiO_2 < 55$ percent). The analyses all plot within the tholeiitic fields on AFM and cation diagrams (Figures 6 and 7). They are predominantly magnesian tholeiites as indicated on Figure 7.

TABLE 4. CONTINUED.

MAJOR OXIDES	86JAA-0414	86JAA-0415	86JAA-0462	86JAA-0468	86JAA-0600	86JAA-0609
SiO_2 (wt%)	55.40	53.70	66.40	66.40	48.30	49.90
TiO_2	0.38	0.92	0.36	0.66	1.86	0.53
Al_2O_3	17.00	17.30	17.00	15.70	14.50	18.30
Fe_2O_3	6.68	8.14	3.48	3.52	14.60	9.08
FeO	00.00	00.00	00.00	00.00	00.00	00.00
MnO	0.11	0.11	0.05	0.03	0.33	0.11
MgO	6.36	5.50	1.83	2.06	5.36	6.64
CaO	6.52	4.94	3.33	3.13	8.60	8.26
Na_2O	3.74	4.30	3.91	3.26	2.91	2.45
K_2O	1.73	1.89	2.44	2.87	0.34	1.00
P_2O_5	0.19	0.38	0.10	0.14	0.17	0.08
CO_2	0.25	0.13	0.30	0.15	0.45	0.14
S	0.01	0.01	0.01	0.01	0.01	0.01
H_2O^+	00.00	00.00	00.00	00.00	00.00	00.00
H_2O^-	00.00	00.00	00.00	00.00	00.00	00.00
LOI	1.90	2.60	0.90	0.70	2.10	2.90
total	100.00	99.80	99.80	98.50	99.00	99.30
sg	2.84	2.78	2.72	2.70	3.01	2.93

TRACE ELEMENTS*	86JAA-0414	86JAA-0415	86JAA-0462	86JAA-0468	86JAA-0600	86JAA-0609
Ag (ppm)	-2	-2	-2	-2	-2	-2
Co	28	25	8	10	35	34
Cr	274	211	39	68	99	125
Cu	34	28	30	14	88	8
Ni	100	69	14	26	48	128
Pb	20	13	23	26	-10	-10
Zn	74	97	52	52	210	52
Nb	-5	6	-5	6	5	-5
Rb	70	92	82	98	12	24
Sr	538	472	434	450	209	377
Y	16	21	13	15	44	15
Zr	133	215	163	189	134	106
Th	14	18	11	15	-10	-10
Pr					2.9	2.5
Sm					4	2.2
Eu					1.4	830 ppb
Gd					5.1	2.2
Tb					890 ppb	340 ppb
Dy					5.8	2.1
Ho					1.3	440 ppb
Er					3.8	1.3
Tm					520 ppb	180 ppb
Yb					3.4	1.2
Lu					500 ppb	200 ppb
Au	-2 ppb	-2 ppb	-2 ppb	-2 ppb	-2 ppb	-2 ppb
Pt	3 ppb	4 ppb	1 ppb	-1 ppb	-1 ppb	-1 ppb
Pd	-1 ppb	25 ppb	-1 ppb	-1 ppb	-1 ppb	-1 ppb
Ce					17	17
La					6.8	8
Nd					14	9.8
Y					30	9.1

Chondrite normalized plots of rare earth elements (REE) for the Lower Mafic Unit basalts (Figure 8) show relatively flat patterns with some depletion of light rare earth elements (LREE).

This feature has also been documented from the Lower Mafic Unit basalts in the Bigstone Bay area (Stix 1985). In addition, plots from basalts of this unit in the Rat Portage Bay area also show the same pattern of depletion of LREE (Ayer 1987).

UPPER MIXED UNIT

Basalts of the Upper Mixed Unit are also of tholeiitic composition, as indicated by the AFM and cation diagrams (Figures 6 and 8). Unlike the magnesian tholeiites of the Lower Mafic Unit within the map area, basalts of the Upper Mixed Unit are predominantly iron tholeiites (Figure 7). However, iron-rich tholeiites have been observed as being relatively extensive within the Lower Mafic Unit to the east in the Bigstone Bay area

TABLE 4. CONTINUED.

MAJOR OXIDES	86JAA-0627	86JAA-0629	86JAA-0630	86JAA-0631	86JAA-0632	86JAA-0634
SiO_2 (wt%)	74.40	58.50	56.60	75.90	74.80	79.10
TiO_2	0.29	0.95	1.33	0.13	0.15	0.04
Al_2O_3	14.00	17.10	14.90	11.20	10.30	10.80
Fe_2O_3	1.89	8.31	12.00	1.03	1.73	0.88
FeO	00.00	00.00	00.00	00.00	00.00	00.00
MnO	0.01	0.13	0.16	00.00	0.03	00.00
MgO	0.02	4.00	6.24	0.87	1.04	0.26
CaO	0.52	2.29	1.49	1.27	2.19	0.60
Na_2O	4.16	5.25	2.99	1.28	0.87	0.34
K_2O	2.23	0.04	0.06	5.37	4.63	6.38
P_2O_5	0.01	0.18	0.07	00.00	00.00	0.01
CO_2	0.44	0.22	0.19	2.12	3.55	0.91
S	0.14	0.01	0.01	0.01	0.01	0.01
H_2O^+	00.00	00.00	00.00	00.00	00.00	00.00
H_2O^-	00.00	00.00	00.00	00.00	00.00	00.00
LOI	1.40	2.40	3.50	2.20	3.70	0.90
total	98.90	99.10	99.30	99.20	*99.40	99.30
sg	2.67	2.75	2.77	2.65	2.68	2.63

TRACE ELEMENTS*	86JAA-0627	86JAA-0629	86JAA-0630	86JAA-0631	86JAA-0632	86JAA-0634
Ag (ppm)	-2	-2	-2	-2	-2	-2
Co	6	24	42	-5	-5	-5
Cr	-10	39	207	-10	-10	-10
Cu	12	31	62	32	7	7
Ni	-5	37	118	-5	-5	-5
Pb	-10	-10	-10	47	38	36
Zn	12	66	142	13	26	46
Nb	23	9	-5	12	11	25
Rb	50	-5	-5	75	89	157
Sr	55	122	29	41	41	54
Y	69	25	21	37	30	45
Zr	200	165	75	115	110	91
Th	16	10	-10	13	-10	24
Pr	9.8	5.4	1.3	9.8	6.2	4.2
Sm	8.4	4.2	2	8.2	5	6.6
Eu	1.1	1.3	510 ppb	520 ppb	430 ppb	110 ppb
Gd	7.6	3.9	2.6	6.8	4.2	7.4
Tb	1.1	560 ppb	490 ppb	1	690 ppb	1.3
Dy	7.5	3.5	3.1	5.5	4.2	7.7
Ho	1.6	690 ppb	690 ppb	1.1	820 ppb	1.6
Er	5	1.8	1.9	3	2.4	4.4
Tm	800 ppb	250 ppb	260 ppb	410 ppb	350 ppb	640 ppb
Yb	5.8	1.8	1.8	2.6	2.5	4.9
Lu	900 ppb	250 ppb	250 ppb	400 ppb	420 ppb	710 ppb
Au	-2 ppb	-2 ppb	-2 ppb	-2 ppb	5 ppb	5 ppb
Pt	-1 ppb	-1 ppb	-1 ppb	-1 ppb	25 ppb	2 ppb
Pd	-1 ppb	-1 ppb	-1 ppb	-1 ppb	16 ppb	1 ppb
Ce	76	42	8.3	75	51	27
La	33	19	2.8	33	22	10
Nd	36	20	6.2	37	22	17
Y	39	17	12	24	21	38

(Ayer et al. 1987; Stix 1985) and the Rat Portage Bay area (Ayer 1987). Basalts of these two units can be distinguished geochemically on the basis of REE patterns. Figure 9 shows the chondrite normalized values of REE for the basalts of the Upper Mixed Unit. When compared with those of the Lower Mafic Unit (Figure 8), these rocks are distinctly enriched in LREE, showing ratios of La:Lu generally greater than 1 (*see* Figure 9).

Intermediate flows of the Upper Mixed Unit range from basaltic-andesite to andesite in composition. They are distinctly calc-alkalic in chemical affinity as indicated on the AFM and cation diagrams (Figures 6 and 7). Chondrite normalized plots of these rocks (Figure 10) indicate moderate to strong enrichment in LREE, similar but with generally steeper slopes than the plots of the basalts of the Upper Mixed Unit (*see* Figure 9).

Analyses of felsic volcanic rocks of the Upper Mixed Unit all come from one ignimbrite horizon on Zigzag Island. They are high silica rhyolites (SiO_2 >75 percent) with a calc-alkalic chemical affinity, as indi-

TABLE 4. CONTINUED.

MAJOR OXIDES

	86JAA–0748	86JAA–0753	86JAA–0755	86JAA–0756
SiO_2 (wt%)	63.20	58.30	60.30	49.00
TiO_2	0.42	1.22	0.57	0.70
Al_2O_3	16.40	16.60	16.80	16.10
Fe_2O_3	3.80	7.55	7.10	12.70
FeO	00.00	00.00	00.00	00.00
MnO	0.03	0.11	0.08	0.20
MgO	1.64	3.18	3.44	7.12
CaO	2.60	3.99	5.67	11.30
Na_2O	5.55	3.86	0.46	1.87
K_2O	2.99	2.71	2.55	0.10
P_2O_5	0.21	0.69	0.09	0.04
CO_2	1.85	0.44	0.13	0.57
S	0.02	0.25	0.02	0.02
H_2O^+	00.00	00.00	00.00	00.00
H_2O^-	00.00	00.00	00.00	00.00
LOI	2.50	1.60	2.90	0.90
total	99.30	99.80	99.90	100.00
sg	2.69	2.79	2.84	3.01

TRACE ELEMENTS*

	86JAA–0748	86JAA–0753	86JAA–0755	86JAA–0756
Ag (ppm)	–2	–2	–2	–2
Co	8	20	19	48
Cr	36	53	85	360
Cu	13	53	24	37
Ni	15	29	45	117
Pb	35	12	–10	48
Zn	69	68	81	100
Nb	7	11	–5	–5
Rb	111	58	97	–5
Sr	743	552	283	89
Y	16	24	13	21
Zr	204	248	172	64
Th	11	15	–10	–10
Pr		23	4.6	840 ppb
Sm		11	3.2	1.5
Eu		2.6	950 ppb	550 ppb
Gd		7.2	3	2.4
Tb		950 ppb	440 ppb	400 ppb
Dy		4.3	2.5	2.8
Ho		800 ppb	480 ppb	620 ppb
Er		2	1.3	1.9
Tm		280 ppb	170 ppb	290 ppb
Yb		1.7	1.1	1.8
Lu		260 ppb	180 ppb	290 ppb
Au	–2 ppb	–2 ppb	–2 ppb	–2 ppb
Pt	–1 ppb	–1 ppb	–1 ppb	9 ppb
Pd	–1 ppb	–1 ppb	–1 ppb	10 ppb
Ce		185	39	5.2
La		84	20	1.9
Nd		80	17	4.2
Y		19	11	13

* *negative values are below detection limits*

cated on the AFM and cation diagrams (Figures 6 and 7). Petrographically, these rhyolitic ignimbrites are dissimilar from other felsic volcanic rocks, in the map area and areas to the east (Ayer et al. 1987; Ayer 1987), in that they contain abundant alkali feldspar phenocrysts. In addition, this ignimbrite horizon is petrochemically dissimilar in the REE patterns. These patterns show a distinct enrichment in heavy rare earth elements (HREE) and europium (Eu) depletion anomalies (Figure 11). For comparative purposes, REE patterns of rhyolites from the Rat Portage Bay area are also shown (Figure 12).

This feature of relative enrichment of HREE and Eu depletion is very similar to that observed from some of the Cenozoic ash flow sheets in the southwestern part of the United States, such as the Bishop Tuff (Hildreth 1979). The most plausible explanation for such a feature is eruption from a high-level, compositionally zoned

TABLE 5. DESCRIPTION OF ANALYZED SAMPLES FROM THE CLEARWATER BAY AREA.

Sample No.	Description	Sample No.	Description
86JAA-0020	pillowed intermediate flow	0405	alkali feldspar megacrystic granodiorite
0027	amphibole-plagioclase porphyry	0414	coarse-grained diorite
0037	massive mafic flow	0415	coarse-grained diorite
0038	massive mafic flow	0462	quartz monzodiorite
0075	massive mafic flow	0468	quartz monzodiorite
0142	intermediate massive flow or tuff	0600	massive mafic flow
0168	plagioclase porphyritic mafic sill or flow	0609	leucogabbro
0172	pillowed mafic flow	0627	felsite
0310	magnetitic gabbro	0629	intermediate massive flow
0331	pillowed mafic flow	0630	intermediate pillowed flow
0335	massive mafic flow	0631	quartz-feldspar crystal tuff
0349	peridotite	0632	quartz-feldspar crystal tuff
0358	pillowed mafic flow	0634	felsic lithic tuff
0359	massive mafic flow	0748	plagioclase-alkali feldspar porphyry
0371	pillowed intermediate flow	0753	intermediate amygdaloidal flow
0377	pillowed intermediate flow	0755	intermediate pillowed flow
0380	felsic lithic tuff	0756	pillowed mafic flow

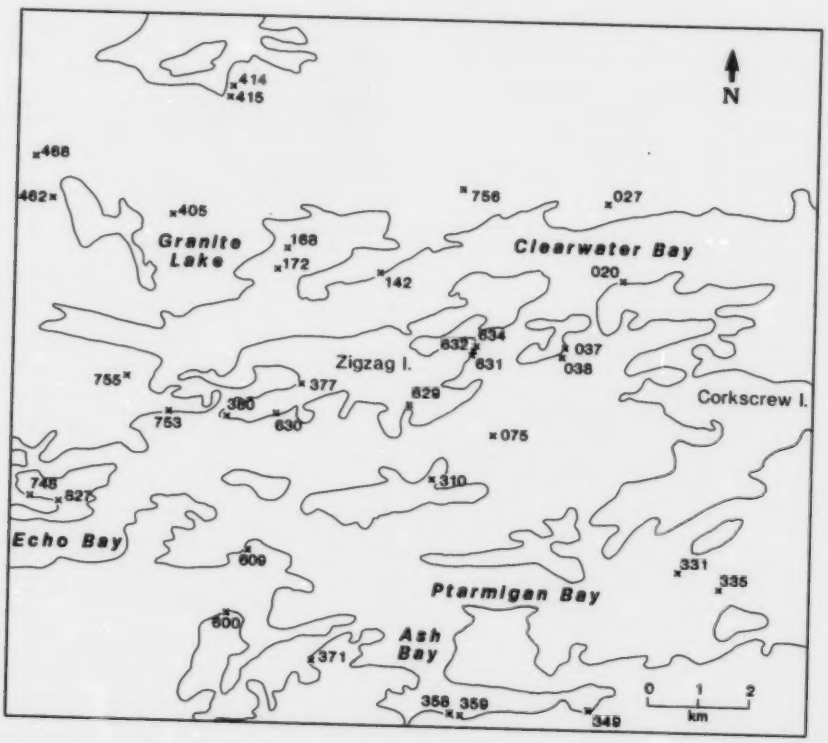


Figure 4. Sample locations for analyzed rocks from the Clearwater Bay area.

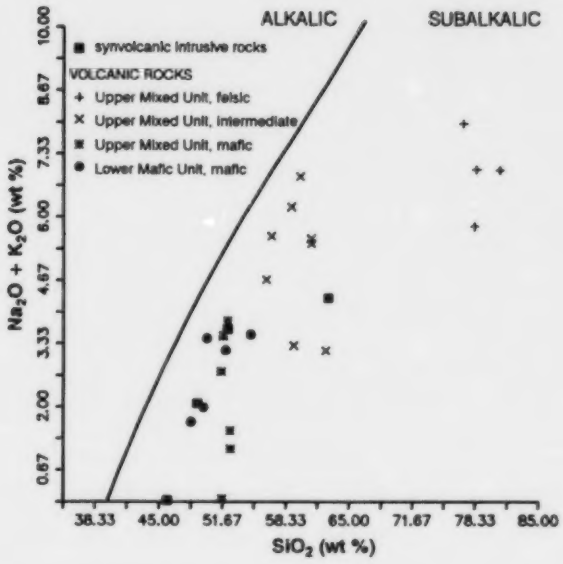


Figure 5. $Na_2O + K_2O$ versus SiO_2 diagram of volcanic and synvolcanic intrusive rocks from the Clearwater Bay area.

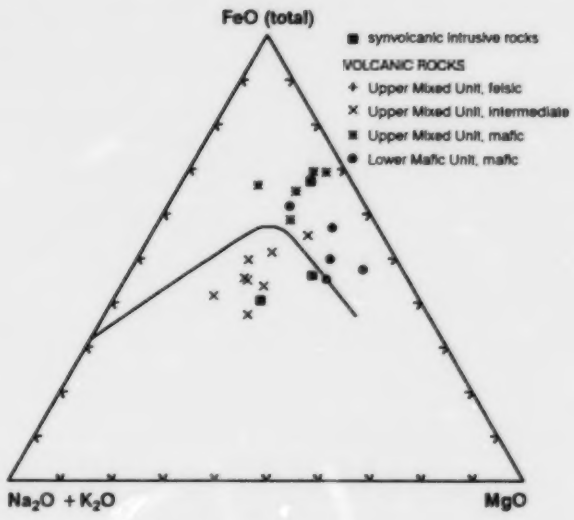


Figure 6. AFM diagram of volcanic and synvolcanic intrusive rocks from the Clearwater Bay area.

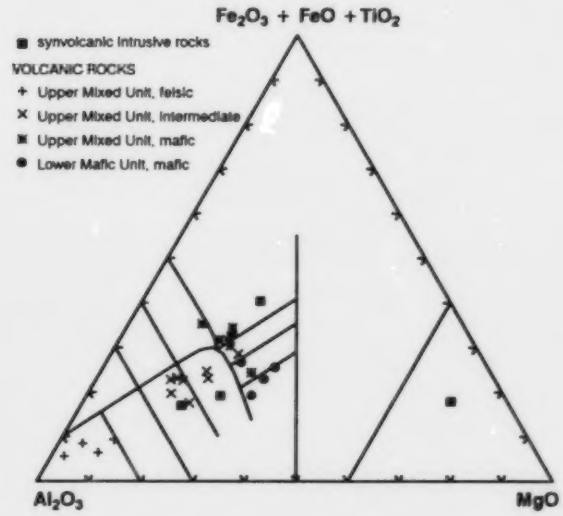


Figure 7. Jensen cation diagram of volcanic and synvolcanic intrusive rocks from the Clearwater Bay area.

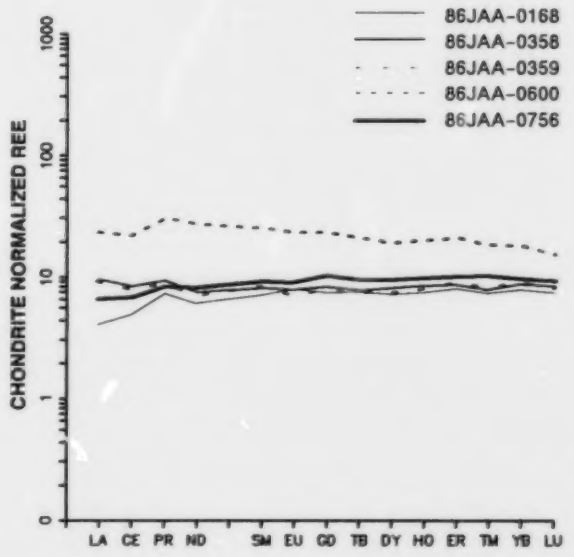


Figure 8. Chondrite plot of REE for Lower Mafic Unit mafic volcanic rocks from the Clearwater Bay area.

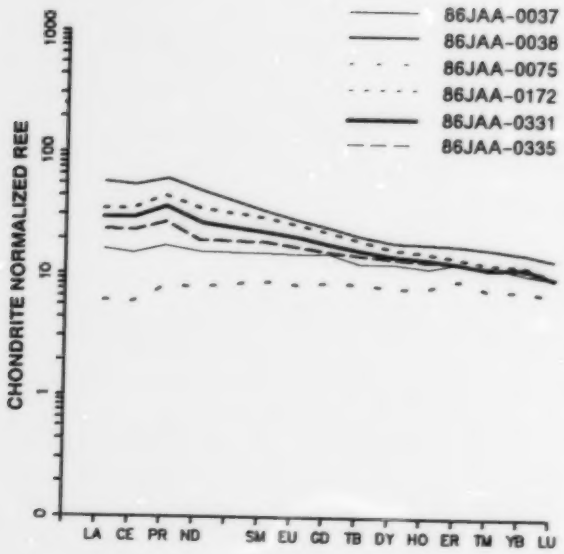


Figure 9. Chondrite plot of REE for Upper Mixed Unit mafic volcanic rocks from the Clearwater Bay area.

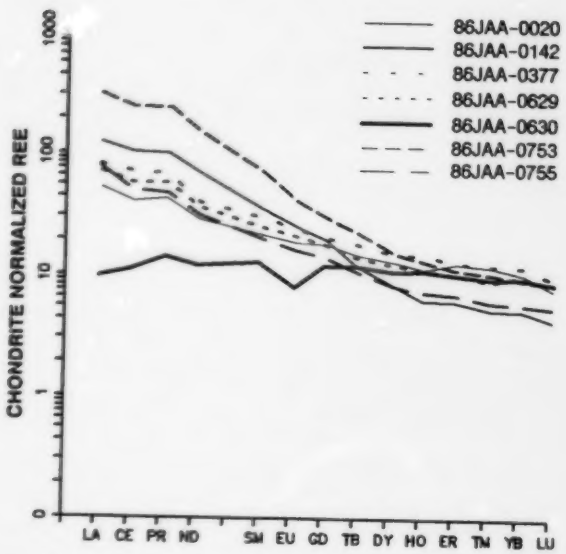


Figure 10. Chondrite plot of REE for Upper Mixed Unit intermediate volcanic rocks from the Clearwater Bay area.

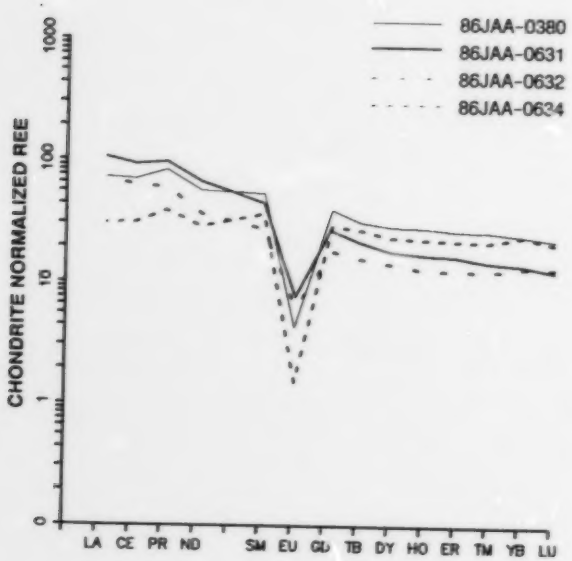


Figure 11. Chondrite plot of REE from the Upper Mixed Unit felsic ignimbrite horizon on Zigzag Island.

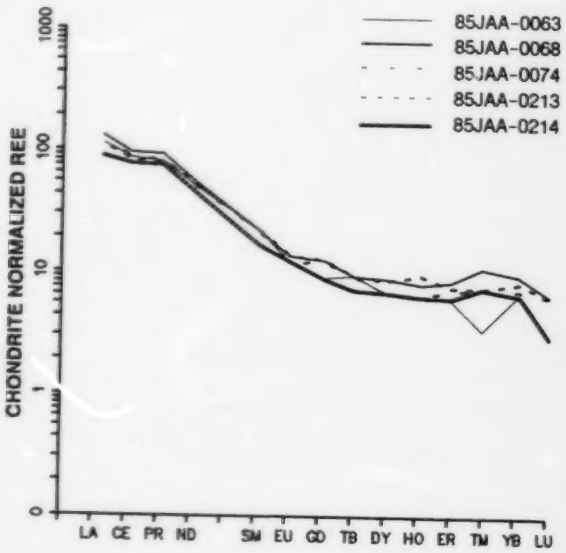


Figure 12. Chondrite plot of REE for felsic volcanic rocks from the Rat Portage Bay area (Ayer 1987).

magma chamber as the source of the ignimbrites (Hildreth 1979, 1981).

In the Cenozoic, felsic volcanic rocks having these patterns of enriched HREE and Eu depletion are commonly associated with mineralization such as rare metals, and precious and base metal deposits, e.g., in the southwestern United States (Burt et al. 1982). In the Archean, these rocks are in many places associated with massive Cu-Zn sulphide mineralization and are considered to be "prime exploration targets" (Campbell et al. 1982).

SYNVOLCANIC INTRUSIVE ROCKS

A sample of peridotite from a differentiated sill south of Ash Bay falls within the komatiitic ultramafic field on the cation diagram (Figure 7). This intrusion occurs in basalts of the Lower Mafic Unit and displays a low and flat trend of REE similar to that of the basalts (Figure 13, sample number 349). The other analyzed synvolcanic intrusions occur within the Upper Mixed Unit: these are of gabbro (sample number 310), which falls in the high iron tholeiite field on Figure 7; leucogabbro (sample number 609), occurring in the calc-alkalic basalt field of Figure 7; and plagioclase porphyry, occurring in the calc-alkalic andesite field on Figure 7. Their REE patterns (Figure 13) are similar to those of the volcanic rocks of the Upper Mixed Unit (i.e., enriched in LREE—compare with Figures 8, 9 and 10). The similarity of REE patterns between the intrusive and volcanic rocks in the Lower Mafic and Upper Mixed units, respectively, implies the intrusions were derived from the same magma sources for each of these units, respectively, and that the volcanism and intrusions probably occurred more or less simultaneously.

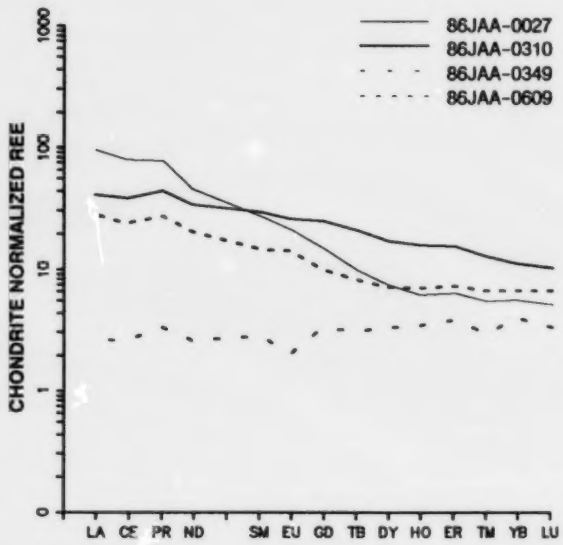


Figure 13. Chondrite normalized plot of REE for synvolcanic intrusive rocks from the Clearwater Bay area.

Metamorphism

Metamorphism to greenschist facies occurs in the supracrustal rocks throughout most of the map area. The lack of rocks of suitable composition (i.e., pelitic sedimentary rocks) precludes further subdivision of the greenschist facies. Generally within 1 km of the large intrusive masses in the north, supracrustal rocks have been metamorphosed to amphibolite facies (based on the presence of hornblende and plagioclase).

Mafic and intermediate metavolcanic rocks of the greenschist facies contain assemblages of albite, epidote and actinolite or tremolite, with or without chlorite, biotite, quartz and carbonate. Those of the amphibolite facies contain plagioclase (oligoclase to andesine) and hornblende, with or without epidote, chlorite, garnet, quartz and carbonate.

All felsic metavolcanic rocks observed occur within the greenschist facies and contain assemblages of albite, quartz, epidote and sericite, with or without microcline, biotite, chlorite and carbonate.

Effects of localized high strain are evident throughout the map area. Strained zones are generally highly schistose with a phyllonitic texture indicative of mylonitization accompanied, or postdated by, metamorphic growth of lepidoblastic micas. High strain zones are also commonly enriched in carbonate that is typically of a brown-weathering, iron-rich variety. Where mafic rocks are transected by high strain zones, a chlorite-carbonate schist is developed; a sericite-carbonate schist is developed in the felsic rocks.

Structural Geology

A series of east- to northeast-trending tight folds and a broad easterly trending shear zone are the dominant structural elements within the map area (Figure 2).

East of the map area, two separate phases of folding have been recognized in the refolding of D_1 folds by a later D_2 event (Ayer and Gil 1986; Sanborn 1986). Two phases of folding have also been suggested to the west of the map area (Davies 1965). Within the map area, no refolding of earlier folds was recognized by the field party. This suggests that either the map area is a domain where only one phase was operative, or where the similar attitude of the two phases did not result in well-developed refolding of earlier structures.

A broad shear zone in the south is referred to as the Crowduck Lake–Witch Bay shear zone (Figure 2). In the Rat Portage Bay area, east of the map area, Sanborn (1986) has stated that:

> The shear zone is characterized by steep easterly plunging mineral lineations and shows evidence of major reverse, north-side-up displacement. Locally, horizontal surfaces display S fabric (schistosity) rotated into east-trending C fabric (shear planes) consistent with transcurrent dextral displacement. These fabrics may reflect reactivation of the shear zone.

Study of the shear zone west of the map area has also revealed kinematic evidence to suggest subhorizontal and subvertical displacement. In this area, subhorizontal movement was also dextral, but preliminary results suggest subvertical displacement resulted in the south side moving up (Smith and Thomas 1986).

These studies indicate the kinematics of the Crowduck Lake–Witch Bay shear zone were complicated and that there were two or more directions of displacement and a relatively long and complex structural history.

FOLDING

Fold axes have been located to a large extent on the basis of reversals in facing directions. A major syncline trends east across the map area, from south of Woodchuck Bay and across the northern part of Corkscrew Island (Map 2549, back pocket). A parallel anticline and syncline just north of this major syncline are well defined in the White Partridge Bay Group, and can be extended (on a more conjectural basis) to about halfway across the map area. These structures may extend farther west, but no reversals in facing directions were observed to support this. These three fold axes can be traced eastward into White Partridge Bay (Ayer and Gil 1986). The major syncline appears to be continuous to the west of the map area, with a syncline indicated by Davies (1965) northwest of Chebucto Lake.

A minor anticline and a syncline are indicated on Map 2549 (back pocket), west of the central part of Corkscrew Island. The anticline may extend easterly across Corkscrew Island to join with an anticline identified on the east side of the island (Ayer and Gil 1986).

Another minor anticline has been identified trending northeast across Copper Island. A possible alternative would be to join the anticline observed on the east side of Corkscrew Island mentioned previously with the Copper Island anticline. Unfortunately, poor exposure in the central part of Corkscrew Island prohibits resolution of this problem.

A major syncline has been traced in the south from Ogema Bay northeast through the eastern part of Ptarmigan Bay (Map 2549, back pocket). An anticline and a syncline parallel to each other occur in the southeast corner of the map area. This southernmost syncline is continuous with the Labyrinth Bay–Fox Lake syncline identified by Davies (1978) to the south. It can also be traced eastward across the northeastern part of the Western Peninsula (Ayer and Gil 1986). Relatively sparse evidence of top reversals indicate the anticline and syncline north of the Labyrinth Bay–Fox Lake syncline can be traced at least a short distance east of the map area, although no fold traces were indicated on the map face of the Rat Portage Bay sheet, for this area (Ayer and Gil 1986).

Minor folds observable on the scale of an outcrop are rare in the map area, and where observed, are typically in thinly laminated sedimentary rocks. Fold styles are tight to isoclinal with steeply plunging hinges and weak to nonexistent axial planar cleavages.

A steeply dipping flattening fabric related to the folding and/or shearing is developed across the area. It is defined by the flattening of originally equidimensional objects such as amygdules and pillows, and a schistosity defined by the preferred orientation of micaceous minerals. Flattening planes generally strike within 15° of due east.

Lineations are also widespread but are less abundant. These are defined by elongation of originally equidimensional objects and/or a preferred orientation of elongate minerals. The lineations have steep plunges and are generally close to parallel with the flattening plane. Orientations are most commonly east to northeast.

DUCTILE DEFORMATION

Zones of high strain which are interpreted by the author to be shear zones occur throughout the map area. The zones range from a few centimetres to several kilometres in width. The zones consist of highly schistose rock with varying degrees of mylonitization, accompanied or postdated by secondary mica growth which results in a phyllonitic texture. In mafic protoliths, the dominant lepidoblastic mineral is chlorite, and in felsic protoliths the dominant mineral is sericite. These rocks are typically pervasively carbonatized, commonly with a brown weathering iron carbonate. More localized alteration consists of silicification (both pervasive and quartz-carbonate veining), iron sulphide enrichment,

epidotization, and chromium enrichment (i.e., green mica schists).

The largest of the shear zones is the Crowduck Lake–Witch Bay shear zone. The shear zone has been traced for at least 80 km from the Manitoba border (Blackburn 1981) to Gibi Lake (Trowell 1986). The shear zone cuts across the map area from Rush Bay in the west to Ptarmigan Bay in the east. In the map area, the structure consists of alternating zones of highly to moderately strained rock, which can collectively attain widths of as much as 2 km. The amount of deformation is in proportion to the competency of the original rock types. Typically, fine-grained rocks have strongly developed schistosities and alteration, while the cores of medium-grained intrusions are relatively undeformed and unaltered.

Numerous splays project off the main shear zone. One major splay is deflected around the northern margin of the Canoe Lake stock and then to the southwest into Shoal Lake. It has been identified as the Shoal Lake deformation zone and can be traced over a length of at least 30 km to Gull Bay on the southwestern shore of Shoal Lake (Smith and Thomas 1986).

FAULTING

Numerous lineaments identified on aerial photographs have been transferred onto Map 2549 (back pocket). Some of these are attributable to faults or shear zones, others are of uncertain origin. The most prominent trend of lineaments is easterly, parallel to the regional foliation. Northeasterly trending lineaments are also locally present.

Northwest-trending faults with predominantly dextral displacement are indicated on Victoria Island and at the Inglis Lake occurrence (*see* Figure 16).

The diabase dikes were probably intruded into northwest-trending faults of a similar age. The sinistral east-west offset of diabase segments (Map 2549, back pocket) might normally suggest east-trending fault or shear zone displacement postdating dike emplacement. An alternative explanation is suggested from observations in the Rat Portage Bay area to the east (Ayer and Gil 1986). Here, it was observed that the diabase dike was offset by about 1 km across the Crowduck Lake–Witch Bay shear zone. However, within the shear zone, an east-trending, undeformed diabase dike with chilled margins was observed intruding schists between the offset parts. This indicates that the dike postdates the faulting. The dike was therefore following the deformation zone in a sinistral, step-like pattern.

Economic Geology

The map area has a long history of mineral exploration dating back to about 1880. Gold was the focus for the early exploration work and it continues to be the most sought-after mineral commodity to the present time.

Exploration for volcanogenic base metal deposits was the main emphasis in the 1960s and 1970s. Base metal deposits were sought by large-scale airborne and geophysical surveys followed by diamond drilling of the significant anomalies so determined.

From the late 1960s to the present, the southwestern part of the map area underlain by the Canoe Lake stock has been intermittently explored for porphyry-copper-style mineralization.

There are no producers on record for the map area. However, it is certain that many of the early workings produced relatively minor amounts of gold, which were not recorded.

GOLD

Gold mineralization is widespread throughout the map area, with the exception of the large intrusions and the Winnipeg River gneisses in the north. Two distinct styles of mineralization are recognized. In one environment, gold is restricted to distinct quartz veins or to the immediately adjacent wall rock. In the other environment, gold is more broadly dispersed in zones within major ductile shear zones.

Examples of the quartz vein type of mineralization are the Argyle occurrence, the Ash Bay occurrence, the Inglis Lake occurrence, the Three Friends occurrence and the Unicorn occurrence. In this type, the gold is restricted to quartz veins up to 2 m wide. The veins typically occur in moderately to highly schistose wall rock which can be the locus of relatively narrow zones of ductile deformation and alteration up to several metres in width, on either or both sides of the vein. Locally, the veins are deformed with pinch and swell structures or minor drag folds. The veins locally contain carbonate, tourmaline, muscovite and minor sulphides. Varieties of sulphides can include pyrite, arsenopyrite, chalcopyrite, galena and sphalerite. Visible gold has been reported in some of the veins. The wall rock is typically carbonatized, and may be sericitized or chloritized, depending on the composition of the host rock. Up to several percent finely disseminated pyrite is common in the wall rock and it can also contain anomalous gold values.

Examples of shear zone style gold mineralization are the Echo Bay occurrence, the Echola occurrence, the Rush Bay and Homestead occurrences (Homestake Mineral Development Company property), Noranda Exploration Company, Limited, property and the Gauthier and Nonesuch occurrences. In this type of mineralization, gold occurs in highly schistose and altered rocks within broad zones of ductile deformation such as the Crowduck Lake–Witch Bay shear zone or its associated splays. Alteration consists of widespread carbonatization and more localized sericitization and silicification. Gold is most closely associated with quartz flooding (both pervasive and in quartz-carbonate veins) and enrichments of disseminated pyrite up to a maximum of about 10 percent. Locally, gold is also associated with brecciation, where relatively undeformed and highly altered angular fragments occur in a stockwork matrix of quartz and carbonate, with disseminated pyrite in the fragments and the matrix. Such an area occurs at the southwestern tip of Corkscrew Island.

COPPER, MOLYBDENUM, ZINC

The area around Squaw Lake underlain by the Canoe Lake stock has been explored for porphyry copper mineralization since the late 1960s (*see* Falconbridge Limited Property, and Squaw Lake Occurrence).

Campbell (1973) has described the area as follows:

> Porphyry type copper mineralization pervades the Canoe Lake stock. A complex zonal alteration pattern is centred near Squaw Lake and includes potassic, phyllic and propylitic halos. The sulphides are also zoned outwards from an inner area of chalcopyrite and molybdenite outward to pyrite and chalcopyrite, and finally to pyrite and sphalerite.

Mineralization consists of chalcopyrite (commonly altered to malachite), pyrite, pyrrhotite and locally sphalerite concentrated along widely spaced fractures and within thin shear zones. Pyrite and chalcopyrite also occur as minor disseminations within massive phases of the Canoe Lake stock.

DESCRIPTION OF PROPERTIES

Information on recent work in the area has been largely derived from the Resident Geologist's files, Ministry of Northern Development and Mines, Kenora (RGFK), augmented by information from the Assessment Files Research Office, Ontario Geological Survey, Toronto (AFRO). These files contain only sparse records prior to 1950. Thus, early work on the properties listed below is often based on reports of the Ontario Bureau of Mines and the Ontario Department of Mines, as well as on early reports by the Geological Survey of Canada. Ownership of mining rights is sometimes difficult to determine, especially where there are numerous cottage lots. Therefore, the list of properties should be considered only as a guide, particularly for patented land.

SAMPLING BY THE FIELD PARTY

During the field mapping, about 200 grab samples were collected by members of the field party from zones of recognized or potential mineralization throughout the map area. The samples were analyzed by the Geoscience Laboratories Section, Ontario Geological Survey, Toronto, and the results with codes indicating the nature of the mineralization, the width of the zone from which

the grab sample was selected, and the strike of the zones are tabulated in Table 6. The corresponding sample locations are shown on Map 2549 (back pocket).

ARGYLE OCCURRENCE (1)[2]

Several pits, trenches and a shaft are located at this location on Clearwater Bay. The work on this occurrence was done prior to 1885 and is described by Coste (1895).

The area is underlain by intermediate tuff breccias and lapilli tuffs, moderately to strongly foliated with an east-northeast strike. The rocks dip steeply to the north. Locally, the metavolcanic rocks are brownish weathering adjacent to the old workings. In thin section, the brown weathering is seen to be the result of abundant, very fine-grained biotite which appears to be an alteration after amphiboles.

The mineralization near the shaft has been described by Coste (1895) as follows:

> Over a quarter of a mile farther south is the second vein, with a strike of 100°; it dips south the same as the last mentioned vein, is wider (four to seven feet), and seems better defined. Two large pits, one on the shore of the lake, and a second, dignified with the name of shaft, a little further back on the hill, have been made in this vein, the quartz of which is very white and hard and contains a little iron pyrite (pyrite), mispickel (arsenopyrite) and calcite.

A grab sample of the quartz vein with a trace of pyrite, collected from the shaft location by members of the 1986 field party, yielded 365 ppb gold and 4 ppm silver (Table 6, sample 22).

In addition, Coste (1895) described a vein about 400 m north of the above vein. He described it as follows:

> The more northward of the two varies from one to two feet in thickness only; it is very badly defined. It is not a quartz vein sharply cutting the surrounding schist. It has been exposed for about a quarter of a mile, and within that distance four or five large pits have been made in the vein. At one of these pits the vein divides into two small branches which reunite again and enclose between them schists impregnated with iron-pyrite (pyrite) and mispickel (arsenopyrite); in addition to these mineral matters the quartz is mixed with calcite.

It is likely that several old trenches and pits near the shoreline about 300 m northeast of the above mentioned shaft are the easternmost exposure of this "vein". At this location, the intermediate metavolcanic rocks are highly schistose and altered in a zone striking 075° and dipping 70°N; the deformation zone is up to about 10 m wide. It contains locally abundant quartz-carbonate veinlets (up to 3 cm wide) and finely disseminated pyrite.

ECHO BAY OCCURRENCE (2)

A 22 m adit and some trenches were excavated on the north side of Echo Bay in about 1895 by Kendall and Whiting (Davies and Smith 1988). From 1979 to 1983, Tasu Resources Limited conducted geochemical, geophysical and geological surveys, trenching and channel sampling, and diamond drilled three holes having a total length of 315 m.These holes were put down in the vicinity of the adit.

The geology of the area is displayed on Figure 14 and has been reinterpreted after work by Tibbo (1980). Easterly striking, mafic metavolcanic rocks with locally preserved pillow selvages underlie the central part of the area. They have been intruded to the southwest by a gabbro sill. The Rush Bay stock intrudes the volcanic rocks to the north. The stock consists predominantly of plagioclase and alkali feldspar porphyritic quartz monzodiorite. However, it also consists of fine-grained pink felsite which rims the quartz monzodiorite in the southern and western parts of the stock. The Echo Bay occurrence is situated within a zone of moderate to high ductile deformation within the Crowduck Lake–Witch Bay shear zone. As a result of this, all rock types are moderately to highly schistose and locally carbonatized and/or sericitized or chloritized. Foliations trend east to northeast and dip steeply to the north.

The main mineralized zone occurs within an intermediate volcanic unit. The adit crosscuts highly schistose and deformed intermediate pyroclastic rocks which strike between 065° and 080° and dip steeply north. Anomalous gold values occur in widths of up to at least 20 m in the vicinity of the adit, in carbonatized and locally pyritized and silicified schists. The northeast-striking mineralized zone appears to be lenticular, and has been traced by trenching over a length of 160 m (*see* Figure 14). However, a geochemical survey indicates that the mineralized zone may be up to about 460 m long and partly covered by overburden (Tibbo 1980). Silicification consists of discontinuous quartz veinlets up to 15 cm wide. Weakly disseminated pyrite is ubiquitous in the mineralized zone and is locally concentrated in lenses up to 50 cm wide. Free gold has been noted in some of the quartz veins, along with pyrite and galena (Beard and Rivett 1981).

Channel sampling returned the best results from the adit and the trench immediately above it (Figure 14). Reported values from the adit range up to a maximum of 0.17 ounce per ton gold over 1.8 m, and from the trench above the adit 0.106 ounce per ton gold over 4.4 m or 0.148 ounce per ton gold over 1.8 m (Tibbo 1980).

Diamond drilling intersected an anomalous zone beneath the adit (DDH #1, *see* Figure 14) over a width of 24.4 m, with values up to a maximum of 0.074 ounce per ton gold over 0.9 m. A hole drilled northwest of the adit (DDH #3, *see* Figure 14) did not intersect any significantly anomalous zones (Tibbo 1983).

Grab samples of quartz veins with minor disseminated pyrite, collected from the adit by members of the 1986 field party, contained up to 7520 ppb gold (Table 6, sample 51A).

ECHOLA OCCURRENCE (3)

This occurrence consists of an inclined shaft reportedly excavated to a depth of 30 m in 1903 (Beard and Garratt 1976). It is located about 60 m southwest of the westernmost bay of Ptarmigan Bay.

[2] *Numbers in parentheses refer to property numbers on Map 2549 (back pocket).*

TABLE 6. GRAB SAMPLE ASSAY VALUES FOR SAMPLES COLLECTED DURING THE 1986 FIELD SEASON IN THE CLEARWATER BAY AREA.

Sample numbers correspond to location numbers on Map 2549. Gold, platinum and palladium values in ppb or ounce per ton (in parentheses), others in ppm or percentage as indicated. Analyses by the Geoscience Laboratories Section, Ontario Geological Survey, Toronto.

Sample No.	Mineralization*	Au	Ag	Cu	Pb	Zn	Other
1	Aahj/20cm/100°	4	< 2				
2	abh/2m/095°	< 2	< 2				
3	Bh/1m/086°	5	< 2				
4	BAahj/2m	< 2	< 2				
5	BAahj/2m/095°	17	< 2				
6	BAahj	235	2				
7	BAadhj/1.5m/073°	8	< 2				
8	Bhj/75cm/065°	13	< 2				
9	Aahj/30cm/085°	17	< 2				
10	Bh/75cm/056°	13	< 2				
11	Babhj	9	< 2				
12	Bhj/10cm/030°	85	< 2				
13	Aahj	17	< 2				
14	Bh/1m/082°	4	< 2	16	< 10	55	
15	Babh/4m/062°	5	< 2				
16	Bhj/10cm/075°	12	< 2				
17	Aahj/25cm/060°	75	< 2				
18	Aahj/5cm/060°	2090	< 2				
19	BAahl/2m/080°	3830	< 2				As 7.5%
20	BAacf/2m/048°	< 2	< 2				
21	Aahj/15cm/074°	8	< 2				
22	Aahj/2m/065°	365	4				
23	Bbdhj	15	< 2				
24	Bhj/15cm/075°	8	< 2				
25	hk	145	< 2				
26	hj	< 2	< 2	450			Pt < 1, Pd > 1
27A	Aahjlmno/30cm	155	7	81	1490	730	As 1.16%
27B	Aachl/1cm/060°	5	< 2				As 1200
28	Aabhl/1m/045°	22	< 2				As 3400
29A	Aabchl/1m/050°	825	< 2				As 2.6%
29B	Ab/1m/050°	< 2	< 2				
30	Aa/2m/050°	< 2	< 2				
31A	Bahj/50cm/065°	3450	5				
31B	Aa/5cm/065°	260	< 2				
32	Babh/1m/067°	< 2	< 2				
33	hj/10m	< 2	< 2				
34	Bbhj/10cm	8	< 2				
35A	Babhjl/1m/060°	75	< 2	590	72	360	As 370
35B	Babhl/1m/075°	9	< 2	92	< 10	77	As 4900
36	hk/25m	< 2	< 2	46	< 10	100	
37	Babhl/1m/040°	< 2	< 2				
38	Bahj/2m/035°	6	< 2				
39A	Aachj/10cm/078°	(0.60)	26				
39B	Dhj	1230	< 2				
40	Bahj/2m/080°	390	< 2				
41	Aahkm/1cm/075°	5	< 2	164			
42	hjk/15m/060°	27	< 2				
43A	Bafhj/2m/085°	210	< 2				
43B	Bef	2	< 2				
44	Chj	4	3				
45	Bhj	< 2	< 2				
46	Bhj	< 2	< 2				
47A	Aa	5	< 2				
47B	Dehj	< 2	< 2				
48	Bbehj/2m/088°	3	< 2				
49	hj	2	< 2				Pt < 1, Pd < 1
50	Bahj/2m/080°	17	< 2				
51A	Aahj/20cm	7520	< 2				
51B	Bahj	20	< 2				
52	Chj	19	< 2				
53	Bhj/2m/075°	65	< 2				
54A	Aachj/40cm/057°	415	< 2	33		43	
54B	Aachj/40cm/057°	295	< 2	33		40	

TABLE 6. CONTINUED.

Sample No.	Mineralization*	Au	Ag	Cu	Pb	Zn	Other
55	Aachj/2m/065°	5	< 2				
56A	Abhmn/5cm	125	24	1390	1.27%	5	
56B	Dbhj	10	< 2				
56C	Aabhj	7	< 2				
56D	Bhj	10	< 2				
57A	Bahj	800	< 2				
57B	hjp	11	< 2				
57C	Bahj	8000	< 2				
57D	Bhj	65	< 2				
57E	Bahj	2190	< 2				
57F	Baehj	8	< 2				
58	Db	5	< 2	12			
59	Aabhj/40cm/100°	< 2	< 2				
60	Behj/1m/080°	12	< 2				
61	Bhj	< 2	< 2				
62	Bhj/076°	< 2	< 2	37			
63	Aac/1m/052°	< 2	< 2				
64	Cp	< 2	< 2				
65	Babh	< 2	< 2				
66A	Aab/1m	< 2	< 2				
66B	Bahj	4	< 2				
67	Aahkm/2m	< 2	< 2	287			
68	hj	7	2				
69	Bbhj/50cm/045°	< 2	< 2				
70A	Aab/2m/120°	< 2	< 2				
70B	Bhj	< 2	< 2				
71	Aab/3cm/065°	< 2	< 2				
72	Aabhj/2m	< 2	< 2				
73A	Aahjl/20cm/040°	120	< 2				
73B	Aa/5cm/070°	< 2	< 2				As 3.5%
74	Aab/10cm/065°	< 2	< 2				As 62
75	Aahjln/30cm/050°	115	< 2				
76A	Cahj/20m	26	< 2				As 10.8%
76B	Aahl/5mm	5	< 2				
77	Bbehj/1m/077°	3	< 2				As 1200
78A	Bahj/10m/078°	9	< 2	280	16	1430	
78B	Bafhj/10m/078°	18	< 2	123	18	286	
78C	Aahj	5	< 2				
79	Bh/30m/080°	< 2	< 2				
80	Aabf/5cm/070°	< 2	< 2				
81	hjk	< 2	< 2				
82	Bbef/3m	3	< 2				Pt 6, Pd 7
83	Babhj/5m	13	< 2				
84	Bhij/50cm/075°	< 2	< 2				
85	Bij/30cm/090°	15	< 2				
86	Bghj/50cm/090°	21	< 2				
87	Bbhk/10m	18	< 2				
88	Eabhj/10m	9	< 2				
89	Bhj	2	< 2				
90	Aah	2	< 2				
91	Aahj/15cm	< 2	< 2				
92	Aabchj/20cm/076°	< 2	< 2				
93	Aabh/25cm/063°	6	< 2	< 5			Mo < 10
94	bhj	80	< 2	12			Mo < 10
95	hj	6	< 2	6			Mo < 10
96	hj	24	< 2	26			Mo < 10
97	hjm	17	< 2	465			Mo 30
98	hjm	< 2	< 2	97			Mo < 10
99	Bhjm	70	10	590			Mo < 10
100	hjm	9	3	363			Mo < 10, Pt < 1, Pd < 1
101	Babhj/4m	19	< 2	5			
102	hjm	4	< 2	805			
103	Behj	< 2	< 2				
104	hj	2	< 2				
105A	hjp	< 2	< 2				
105B	Bhjm/50cm/093°	7	< 2	224			
106A	BAahj/30m	15	< 2				

TABLE 6. CONTINUED.

Sample No.	Mineralization*	Au	Ag	Cu	Pb	Zn	Other
106B	BAahj/30m	22	13				
106C	BAahj/30m	3	< 2				
107	ae	< 2	< 2				
108	Aahm/20cm/125°	940	95	1.62%			
109	Bhj	4	4				
110	Aabhj/30cm/128°	910	2	38			
111	Aabf/5cm	22	< 2				
112A	Aabhj/30cm/076°	110	< 2				
112B	Db	7	< 2				
112C	Dabhj	4	< 2				
113	Aabc/2m/120°	6	< 2				
114A	Aachjm/35cm/105°	(0.31)	3	905			
114B	Dbc	23	< 2	50			
114C	Aac/15cm/105°	150	< 2	21			
114D	Aachjm/50cm/109°	3700	< 2	470			
115	hjkp	8	< 2				Pt < 1, Pd < 1
116A	hjm/5m	25	< 2	288			
116B	Aa/5cm	260	< 2				
117	hkm	115	7	1950			
118	hj/3m/055°	1560	< 2				
119	hj	60	< 2				
120	Aabh/10cm/110°	< 2	< 2				
121	hj	7	< 2				
122A	hk	8	< 2				
122B	hj	100	< 2				
123	Bhj/5m/105°	16	< 2				
124	Babc/3m/090°	< 2	< 2				
125	Eabhj	540	< 2				
126	Eabhj	1235	< 2				
127A	Eabhj	850	< 2				
127B	Eabhj	360	< 2				
128	Bhj/10m/135°	60	< 2				
129	Caghj/095°	< 2	< 2				
130	ahjk	3	< 2				
131	Bbhij	250	< 2				
132	Bhj	< 2	< 2	36			
133	Aabh/35cm/115°	< 2	< 2				

A	Vein	g	graphite
B	High Strain Zone	h	disseminated sulphides
C	Chemical Sediment	i	massive sulphides
D	Wall Rock	j	pyrite
E	Breccia Zone	k	pyrrhotite
a	quartz	l	arsenopyrite
b	carbonate	m	copper sulphides or oxides
c	tourmaline	n	galena
d	chlorite	o	sphalerite
e	sericite	p	magnetite
f	green mica		

* *Mineralization Code / Width of Vein or Zone / Strike of Vein or Zone*

The shaft was sunk on highly strained and sericitized felsic schists with traces of disseminated pyrite about 300 m north of the contact of the Canoe Lake stock. No quartz vein was observed in outcrop, but small quartz veinlets up to 3 cm thick with minor amounts of pyrite were observed in the muck pile.

A grab sample of sericitized schist with minor disseminated pyrite was submitted for analysis but did not contain anomalous gold (Table 6, sample 103).

FALCONBRIDGE LIMITED PROPERTY (4)

This property consists of two separate claim groups. The large group consists of 13 claims (numbers 850373 to 850379, 882042 to 882044, and 882050 to 882052 inclusive) and is a part of a larger group which extends from Squaw Lake to west of the map area. It is underlain by the Canoe Lake stock in an area which has been highly fractured, altered and locally mineralized. Campbell (1973) described the mineralization in this area as follows:

> The copper-molybdenum-zinc mineralization in the Canoe Lake stock can be classified as porphyry copper type. Although the mineralization is not of ore grade and such a possibility is rather remote, the type of sampling undertaken in the area of highest copper-molybdenum-zinc mineralization and the extent of overburden and water in the area of most concentrated mineral occurrences does not preclude the possibility of the presence

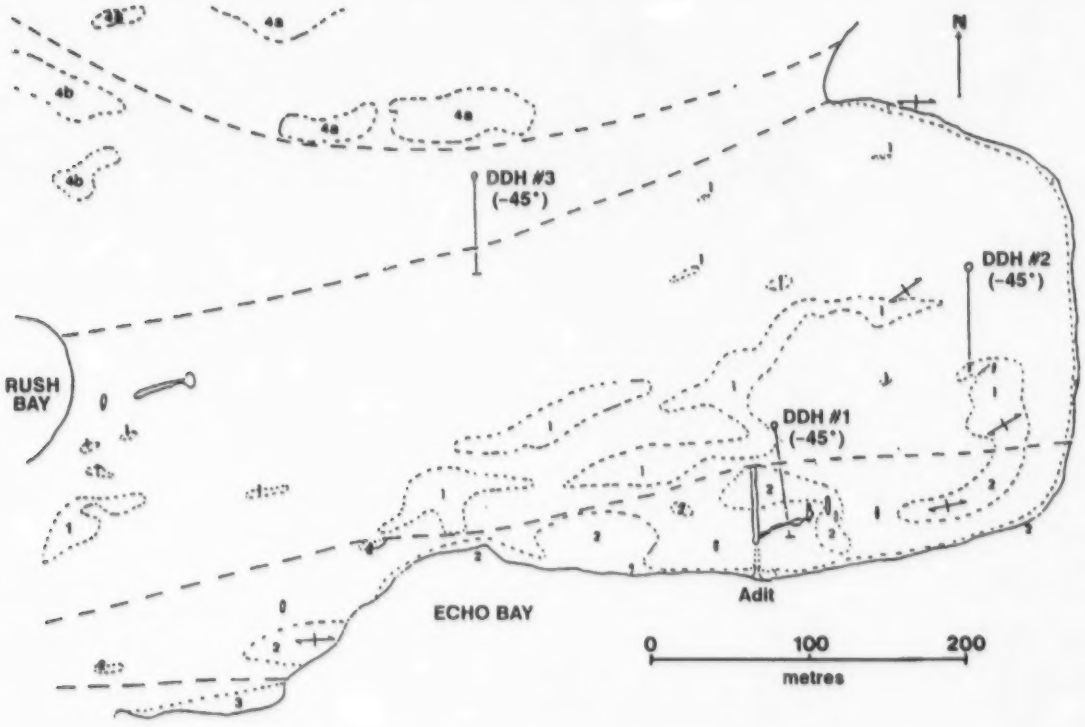


Figure 14. Echo Bay occurrence (modified after Tibbo 1980).

of a significant porphyry copper deposit (L. King, personal communication).

Grab samples of the stock containing disseminated sulphides collected from this area ranged up to 590 ppm copper, 30 ppm molybdenum, 70 ppb gold and 10 ppm silver (Table 6, samples 95 to 99).

Ash Bay Occurrence

A second, smaller claim group held by Falconbridge Limited consists of four claims (numbers 855382 to 855385) on the old Ash Bay occurrence. This occurrence consists of a shaft and several trenches on an island in the northwestern part of Ash Bay. The date of these excavations is unknown. However, the work was done sometime prior to 1935, as it was described by Thomson (1937, p.38).

The area is underlain by intermediate fragmental volcanic rocks ranging from tuffs to tuff breccias with intercalated amygdaloidal pillowed and plagioclase-phyric intermediate flows in the west. The volcanic rocks are intruded by a thick, locally differentiated mafic sill north of the showings.

Gold and copper mineralization occurs in a quartz vein exposed over a strike length of about 80 m (Figure 15). The vein ranges in width from 10 to 50 cm, and in strike and dip from 105/55N to 109/61N. It consists of white vitreous quartz with minor iron carbonate and thin fractures filled with black tourmaline. Sulphides are minor disseminated pyrite and erratically distributed chalcopyrite up to about 5 percent. The wall rock is carbonatized and buff weathering for up to 3 m on both sides of the vein.

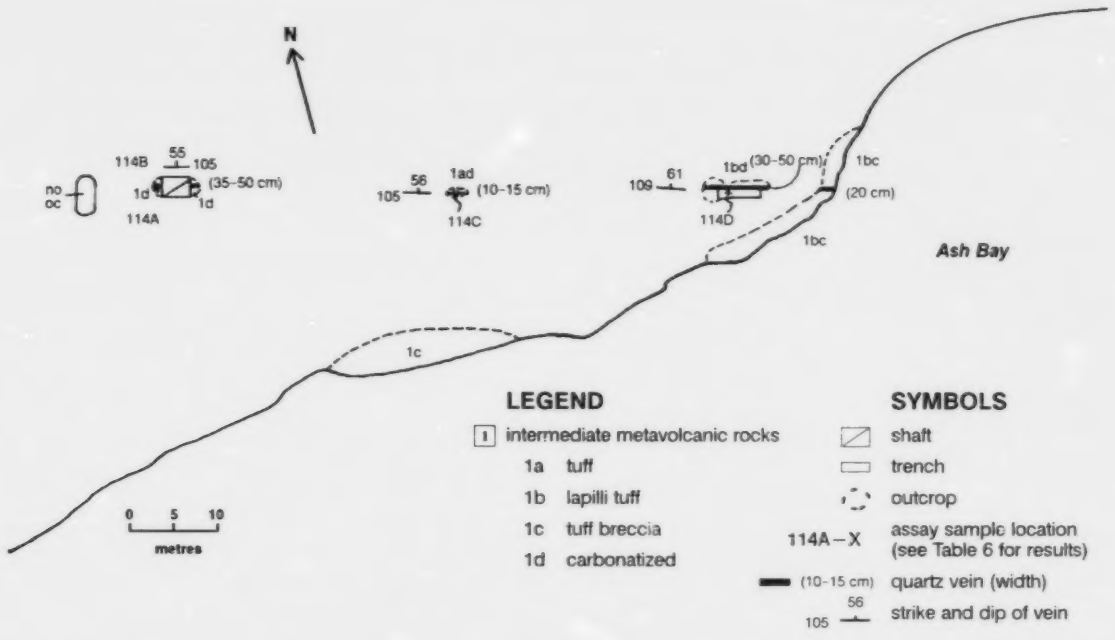


Figure 15. Falconbridge Limited property (Ash Bay occurrence).

Thomson (1937) reported an assay value of 0.19 ounce per ton gold from a grab sample of quartz vein "well-mineralized" with chalcopyrite.

Grab samples of quartz collected by members of the 1986 field party from various locations on the vein (Figure 15) indicate values which range from a low of 150 ppb gold and 21 ppm copper to a high of 0.31 ounce per ton gold and 905 ppm copper (Table 6, samples 114A to 114D inclusive). These results indicate a positive correlation between gold values and copper content.

GEROUX OCCURRENCE (5)

This occurrence consists of a shallow inclined shaft and a trench reportedly excavated around 1895 by A. Geroux (Davies and Smith 1988).

The mineralization occurs in a easterly striking, fine- to medium-grained, magnetic, mafic sill which is about 100 m thick. A well-preserved cross section about 350 m west of the shaft indicates differentiation from melagabbro in the north to quartz gabbro in the south and suggests tops to the south. The sill is intruded into variolitic, pillowed, aphyric mafic flows to the north and intermediate, plagioclase-phyric pillowed flows to the south.

The mafic intrusion is strongly carbonatized in the vicinity of the shaft, locally with abundant fine- to medium-grained magnetite.

A vein striking at 076° and dipping 57° to the north was observed in the west wall of the shaft. It pinches and swells from 5 to 30 cm in thickness in this wall and down to about 3 cm in the east wall. It was not observed in the 10 m long trench extending to the shoreline east of the shaft. The vein consists of white, medium-grained sugary quartz and iron carbonate with minor fine-grained disseminated pyrite.

A grab sample of quartz from the shaft collected by members of the 1986 field party and submitted for analysis yielded 110 ppb gold (Table 6, sample 112A).

A small open cut was observed along the shoreline about 500 m southwest of the shaft. A quartz vein at this locality ranges from 5 to 30 cm in width and strikes at 128° with a dip of 36°to the southwest. The quartz is white with minor amounts of iron carbonate, pyrite and chalcopyrite. A grab sample of this vein was analyzed and yielded 910 ppb gold (Table 6, sample 110).

HOMESTAKE MINERAL DEVELOPMENT COMPANY PROPERTY (6)

This company presently holds 92 claims (numbers 803606 to 803698 inclusive) within the map area. The claims extend east along the Crowduck Lake–Witch Bay shear zone. In 1985, an airborne geophysical survey was conducted over the claims and the surrounding area. The survey types consisted of very low frequency (VLF) electromagnetic, total field magnetic and gradiometer magnetic (the gradiometer survey was not filed for assessment credit).

A wide variety of rock types are covered by the claim group; the main feature is a broad, easterly trending zone of moderately to highly schistose rocks located along the Crowduck Lake–Witch Bay shear zone.

Several mineral occurrences are located within the claim group and are described separately below.

RUSH BAY OCCURRENCE

An adit about 12 m long extends south from the shore in Rush Bay (claim number 803697). This adit was not reported on any previous geological maps of the area. The adit is in carbonatized and sericitized schist containing medium- to coarse-grained augen of alkali feldspar. The schist is derived from alkali feldspar porphyritic quartz monzodiorite of the Rush Bay stock. The adit is situated about 100 m south of the contact of the stock with carbonatized and sericitized intermediate metavolcanic rocks. All these rocks occur within a zone of relatively intense ductile deformation associated with the Crowduck Lake–Witch Bay shear zone. A number of east-trending quartz veins up to 30 cm thick were observed in the walls of the adit. Near the end of the adit, two short crosscuts trend to the east and west of the adit following a network of small, milky white quartz-carbonate veins containing minor amounts of pyrite and traces of galena. The wall rock is highly schistose and silicified and contains 1 to 2 percent disseminated pyrite. Grab samples of a quartz vein and wall rock did not contain anomalous amounts of gold (Table 6, samples 47A and 47B).

HOMESTEAD OCCURRENCE

A 33.5 m deep shaft at the Homestead occurrence was excavated around 1900 by J. Gauthier, J. Earngey and Mr. Birbeck (Davies and Smith 1988). It is located on the southwest side of the westernmost bay of Ptarmigan Bay (claim number 803674). The shaft is in cream-coloured, very fine-grained, highly siliceous tuffs and lapilli tuffs with a foliation trending 103/85N. Alteration consists of localized carbonatization and pervasive silicification. Traces of disseminated pyrite were noted in the felsic volcanic rocks, but no quartz vein was observed. A grab sample of a silicified felsic volcanic rock containing minor pyrite did not contain anomalous amounts of gold (Table 6, sample 107).

HUDSON BAY EXPLORATION AND DEVELOPMENT COMPANY LIMITED (7)

In 1975, six diamond-drill holes with a total length of 684 feet were drilled from the ice, southwest of Zigzag Island. The holes were probably drilled to test conductors located during a large-scale airborne geophysical survey flown in 1972 which was not submitted for assessment credit.

The holes intersected intermediate to felsic metavolcanic rocks with locally intercalated graphitic schist and mineralized zones with up to 20 percent disseminated pyrite and/or pyrrhotite, and traces of chalcopyrite and sphalerite. No assays were reported.

INGLIS LAKE OCCURRENCE (8)

This occurrence is also known as the William's option and the J.H.C. Waite option. It consists of numerous small trenches east of the southeast corner of Inglis Lake, about 1 km west of the Kenricia Mine (just east of east boundary of the map area). The trenches were excavated and a vein channel-sampled in 1936 (Burton and Carufel 1936), under an option by J.H.C. Waite (Thomson 1937, p.36). The occurrence was included in a large claim group surrounding the Kenricia Mine, held by Atikwa Resources Incorporated, and was geologically mapped and prospected by Blakeley and MacMillan (1983).

The area is underlain by easterly striking intermediate debris flows which consist of subangular to subrounded heterolithic clasts ranging from tuff breccia to lapilli tuffs and fine-grained tuff. These rocks are moderately foliated with an easterly strike and steep northwesterly dip. The vein occurs in a pronounced east-northeast-trending depression about 50 m wide. The depression extends to the east and west of the vein. It has been traced over a total distance of about 1.5 km and is interpreted to be the locus of a fault zone (Blakeley and MacMillan 1983).

The quartz vein has been exposed by trenching over a total length of about 100 m (Figure 16). The attitude of the vein ranges from 069/86S to 079/88S. It varies in width from 2 to 68 cm and occurs in intermediate volcanic rocks which are fine grained and highly schistose for up to 1.2 m on either side of the vein. This zone of schistosity continues without an accompanying quartz vein west of the trenches. The vein disappears under heavy overburden to the east.

The vein consists of white to vitreous quartz with varying amounts of black tourmaline and carbonate, and minor to moderate amounts of pyrite. Galena and chalcopyrite, and small particles of visible gold, have also been reported (Burton and Carufel 1936).

Lateral offsets of the vein of up to 5 m between trenches D and F (Figure 16) are probably due to dextral displacement on north-northwest-trending faults.

The vein was channel-sampled by Burton and Carufel (1936) with the following summary of results:

> The vein was channel sampled in several places but values proved to be disappointingly low. Particular attention was given to a favourable appearing section near the east end of the vein and this section was sampled at intervals of 10 feet or less for a distance of 55 feet. Four samples in a length of 20 feet assayed $12.95 (0.37 ounce gold per ton) across 38 inches, $13.30 (0.38 ounce gold per ton) across 36 inches, $4.90 (0.14 ounce gold per ton) across 36 inches, and $5.60 (0.16 ounce gold per ton) across 19 inches, but values in the remaining distance averaged less than $1.00 (0.03 ounce gold per ton; gold valued at $35.00 per oz.)

Grab sampling by members of the field party indicated values of up to 0.60 ounce per ton gold in quartz with tourmaline and pyrite, and 1360 ppb gold in pyritized wall rock adjacent to the vein (Table 7).

KERR ADDISON MINES LTD. (9)

In 1971, Kerr Addison Mines Ltd. diamond drilled nine holes in the map area for a total length of 607 m. Six of the holes were drilled on the central part of Corkscrew Island (a seventh is indicated on OGS Data Series Map

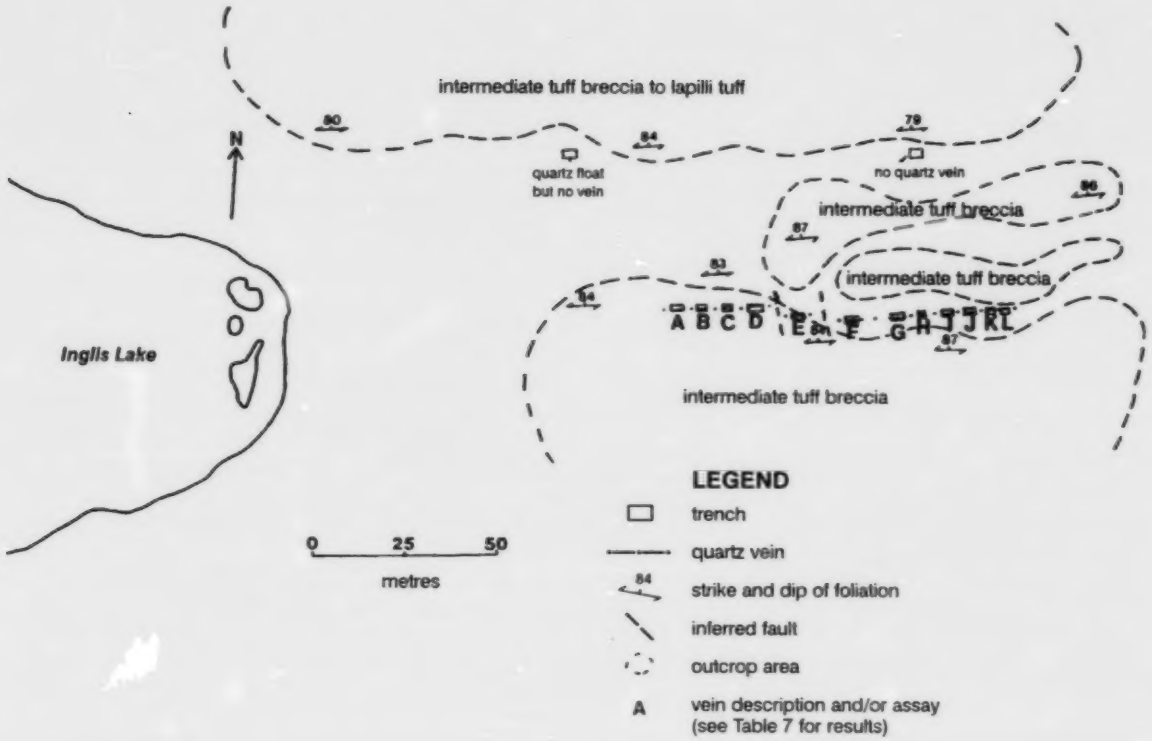


Figure 16. Inglis Lake occurrence.

TABLE 7. GRAB SAMPLE ASSAYS, INGLIS LAKE OCCURRENCE, CLEARWATER BAY AREA.
(see Figure 17 for sample locations)

Trench Sample	Vein Width (cm)	Strike/Dip	Sample Description	Au ppb (oz/t)	Ag ppm
A	2–12		none taken		
B	10		none taken		
C–1	45–65		q.v. with 5% py	700	<2
C–2			wall rock with 5% diss. py 5 cm from vein	490	<2
D–1	55	073/84S	q.v. with 1% py	1250	<2
E–1	15		q.v. with 2% py	6100	8
E–2			wall rock with 1% py 7.5 cm from vein	880	<2
F–1	10	073/90S	q.v. with tr. py & tour	(0.60)	26
F–2			highly schistose wall rock with tr. py	1230	<2
G–1	5–10	071/86S	q.v. with 1–2% py	4000	5
G–2			highly schistose wall rock with tr. py	580	<2
H–1	10	079/88S	q.v. with 5% py & tr. tour	(0.50)	22
I–1	12–18	074/86S	q.v. with tour & 2% py	1540	2
I–2			highly schistose wall rock	440	<2
J–1	38–68		q.v. with 1–2% py	2880	5
J–2			wall rock with 5% diss. py	1360	2
K–1	30–32	075/82S	q.v. with 1% py	3790	34
K–2			wall rock with 3–4% diss. py	440	2
L–1	30–42	069/86S	q.v. with 5% py	4790	4
L–2			wall rock with 5% diss. py 12 cm from vein	475	<2

P.2098, Rivett and MacTavish 1980a, but no log was located for this hole in AFRO).

An additional three holes were drilled from the ice: one southwest of Corkscrew Island; another north of the northeastern tip of Copper Island; and a third south of the northeastern part of Zigzag Island. The holes were probably drilled to follow up electromagnetic anomalies (not filed for assessment credits).

The holes intersected felsic to mafic pyroclastic rocks and flows. In some of the holes volcanic rocks are intercalated with argillaceous to arenaceous interflow sedimentary rocks.

Assay results from several holes indicated trace amounts of gold, silver, copper and zinc in a zone with graphite and up to 25 percent disseminated sulphides. The highest assay results are from the northernmost hole drilled on Corkscrew Island. The mineralization is reported to occur in wacke interlayered with felsic volcanic rocks. The zone consists of 18 m of disseminated sulphides with an average content of 10 to 20 percent pyrrhotite and pyrite, minor chalcopyrite and sphalerite and traces of galena. Gold values range from trace up to a maximum of 0.04 ounce per ton, silver up to 0.04 ounce per ton, copper up to 0.94 percent and zinc up to 1.20 percent (RGFK).

MANITOBA CONSOLIDATED OCCURRENCE (10)

A 75 foot (23 m) shaft was sunk at this location in 1884. The area is underlain by intermediate amygdaloidal flows and tuff breccias. In the vicinity of the shaft, the rock is highly strained with abundant carbonate and hematitic staining and up to about 1 percent finely disseminated pyrite cut by quartz-carbonate veinlets.

No vein was visible at or around the shaft, nor was one observed by Coste (1895) when he visited the property while the shaft was being excavated. A grab sample of chloritized wall rock with disseminated pyrite contained only 15 ppb gold (Table 6, sample 23).

NORANDA EXPLORATION COMPANY, LIMITED PROPERTY (11)

This company currently holds eight claims in the map area in three different locations. The largest claim group consists of four claims (numbers 939626 to 939629 inclusive) northeast of Echo Bay covering the old Nonesuch and Gauthier occurrences; another two claims (numbers 896174 and 939630) are located west of Ogawa Bay and include an old shaft and several pits covering a large gossan zone; the third claim group consists of two claims (numbers 928131 and 928132) south of Echo Bay. These claim groups are part of a larger group (five claims in total) located around the Standard occurrence situated just west of the map area (Beard and Garratt 1976). Mineral occurrences currently held by this company are described below.

Nonesuch Occurrence

The shaft at the old Nonesuch occurrence was excavated to a depth of 21 m by 1895 (Coleman 1896, p.252). The shaft occurs on the eastern tip of a small island (old Mining Location M12) and is currently covered by a wooden deck belonging to a cottage owner who holds the surface rights to the property. The shaft occurs near the contact between easterly striking, highly schistose, intermediate volcanic rocks and a large mafic intrusion to the south. Just south of the shaft on the shoreline are magnetic talc-chlorite-carbonate schists which are probably sheared ultramafic intrusive rocks. An alkali feldspar and quartz porphyry dike up to 3 m wide occurs at the contact striking 075° with a dip of 70° to the north. The shaft was sunk just north of the porphyry dike which at this location contains abundant quartz-carbonate veinlets.

Coleman (1896, p.252) was informed by the owner of the property that:

> At 60 ft (18 m) from the surface, a crosscut was made showing the width of the vein to be 45 feet (14 m), with granite foot wall, the hanging wall is schistose slate. From 500 to 600 tons were mined, assays varying from $6 to $60 per ton *[gold at $20 per ounce]*

Grab samples of vein material from the dump and wall rock to the north and south of the shaft, collected by members of the 1986 field party, did not indicate significant gold values (Table 6, samples 56B, 56C and 56D).

A grab sample from irregular calcite veinlets with localized concentrations of chalcopyrite and galena in talc-chlorite schist, from the shoreline south of the shaft, contained 125 ppb gold, 24 ppm silver, 1390 ppm copper and 1.27 percent lead (Table 6, sample 56A).

Gauthier Occurrence

The old Gauthier occurrence consists of numerous trenches along the shoreline, about 700 m southwest of the Nonesuch shaft (claim number 939626), and an old inclined shaft about 600 m south of the Nonesuch shaft (claim number 939627). The shaft is estimated to be 5 to 10 m deep and was probably excavated around the turn of the century. It is in massive gabbro, which is moderately schistose and carbonatized in the vicinity of the shaft. No quartz vein was observed. A grab sample of sheared and carbonatized gabbro collected by members of the 1986 field party did not contain anomalous gold (Table 6, sample 58).

The trenches on claim number 939626 were excavated and sampled by Sylvanite Gold Mines, Limited, in 1944. Two short holes were diamond drilled beneath one of the trenches in 1949. From 1979 to 1982, Tasu Resources Limited conducted geochemical, geophysical and geological mapping which included the trenched area (RGFK).

Geology of the trenched area is shown on Figure 17. The area is mostly underlain by highly schistose and carbonatized intermediate fragmental volcanic rocks and interbedded fine-grained sedimentary rocks. The sedimentary rocks consist of cherty siltstones and/or argil-

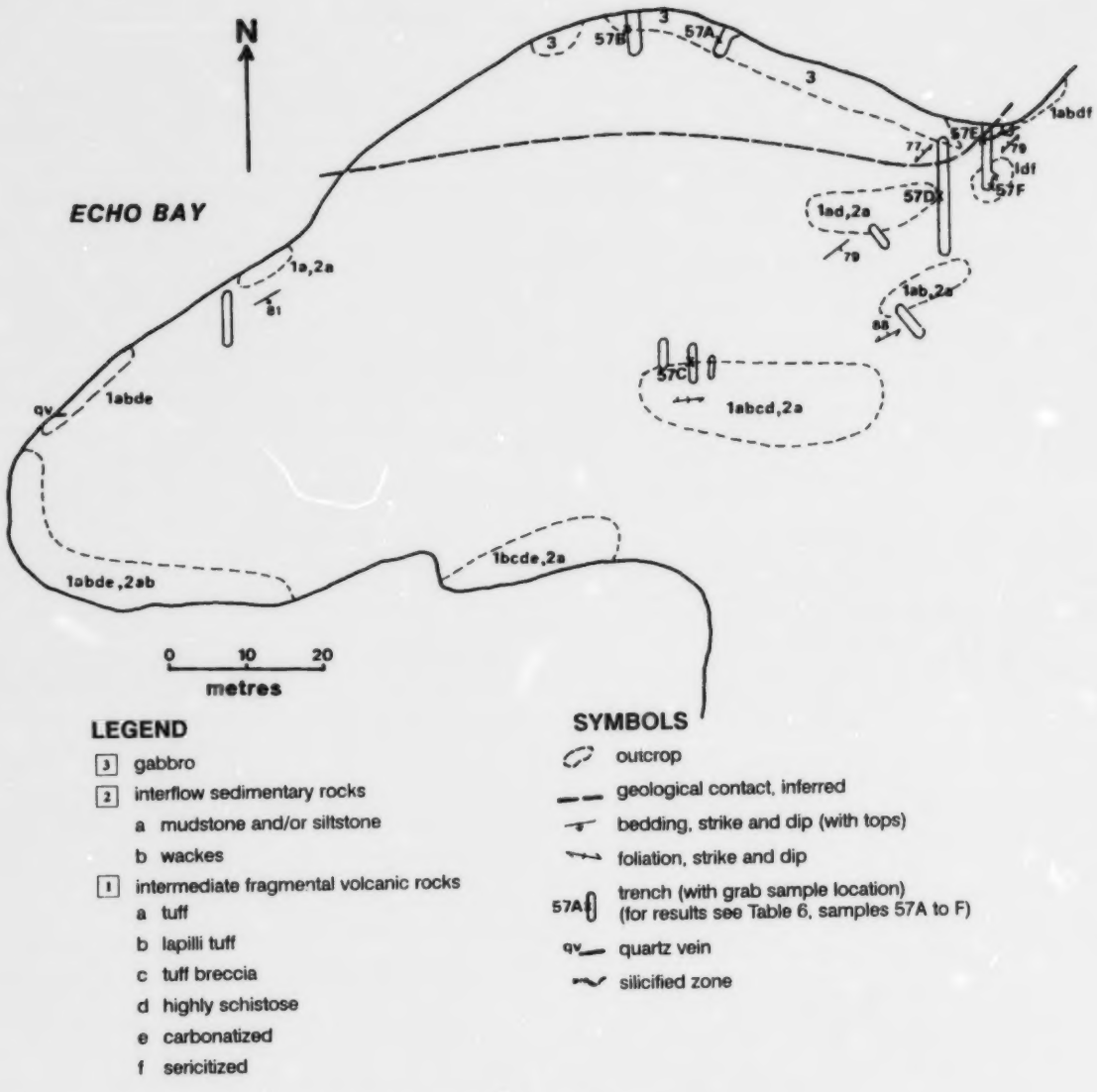


Figure 17. Noranda Exploration Company, Limited property (Gauthier occurrence).

lites with a minor amount of fine-grained wackes in the southwest. Bedding strikes northeast and dips steeply to the southeast. In one locality, well-preserved flame structures indicate tops to the southeast. These supracrustal rocks are cut by a massive, medium-grained, magnetic, gabbro intrusion in the northwest and also a large mafic sill to the east and south (not shown on Figure 17). The area lies within the Crowduck Lake–Witch Bay shear zone and thus finer grained protoliths such as volcanic rocks and sedimentary rocks are highly schistose and are locally strongly carbonatized and/or sericitized and silicified.

Gold mineralization occurs in highly schistose zones in all rock types and is typically accompanied by pervasive silicification and quartz-carbonate veining, pervasive carbonatization, sericitization and up to 5 percent finely disseminated pyrite.

Twelve trenches were excavated and channel sampled by Sylvanite Gold Mines, Limited in 1944 (RGFK) to test the validity of assays from a previous sampling program. The two programs took a total of 84 samples; 32 reported trace gold, while 52 reported values ranging from 0.01 to 0.3 ounce per ton gold over 0.9 m lengths. The longest trench averaged 0.06 ounce per ton gold over 9.6 m, including 0.1 ounce per ton gold over 3.0 m (Tibbo 1982).

Two diamond-drill holes drilled at azimuths of approximately 180° to one another beneath one of the trenches intersected a mineralized zone which assayed $5.90 over 7 feet (0.17 ounce per ton gold over 2.1 m) in

one hole and $2.80 over 7.6 feet (0.08 ounce per ton gold over 2.3 m) in the other hole (Tibbo 1982).

The location of grab samples collected by members of the 1986 field party are shown on Figure 17. Samples of silicified and/or pyritized intermediate volcanic rocks range up to 8000 ppb gold and indicate anomalous gold values over a large area (Table 6, samples 57C to 57F inclusive). Samples of pyritized and silicified gabbro ranged up to 800 ppb gold (Table 6, samples 57A and 57B).

Ogawa Bay Occurrence

An old shaft, estimated to be at least 15 m deep, and several pits were excavated around the turn of the century on a large gossan zone west of Ogawa Bay (in the north part of claim number 896174). The gossan is poorly exposed in the shaft and pits. It appears to be up to 3 m wide and consists of disseminated to massive, medium-grained pyrite and quartz in schistose and carbonatized intermediate pyroclastic rocks cut by quartz-feldspar porphyry dikes. Three grab samples of massive pyrite and quartz collected by members of the 1986 field party contained up to 22 ppb gold and 13 ppm silver (Table 6, samples 106A, 106B and 106C).

G. POGSON PROPERTY (THREE FRIENDS OCCURRENCE) (12)

This property consists of a group of 21 claims (numbers 856186 to 856187, 881836 to 881841, 882174 to 882180, 885746, 885749 and 885759) located on the northwestern part of Zigzag Island. The claims cover four shafts, an adit, and numerous trenches and pits, which are collectively known as the Three Friends occurrence.

The property was originally worked in 1890 (Thomson 1937) and it was during this early period that most of the development work was done. Thomson (1937, p.30) also indicated that the property was acquired by the Clearwater Bay Syndicate but does not mention if any work was done by this organization. In 1981, Denison Mines Limited conducted ground geophysical, geochemical and geological surveys on the property (RGFK).

The property is underlain by intermediate, plagioclase-phyric, pillowed flows and pillow breccia striking east-northeast. Pillow tops indicate that the intermediate flows are overlain by debris flows, containing heterolithic volcanic clasts, to the north (Figure 18). Aphyric mafic flows occur in the southern part of the property. A structural interpretation based on top reversals in the region indicate an anticline trending east-northeast in the intermediate volcanic rocks; thus the mafic volcanic rocks to the south also overlie the intermediate flows. The volcanic rocks are cut by minor quartz-feldspar porphyry intrusions.

The main mineralized zone is intermittently exposed over a strike length of about 1150 m (Figure 18). It consists of discontinuous lensoidal quartz veins up to about 0.60 cm thick striking east-northeast in zones of highly schistose and altered metavolcanic rocks containing disseminated sulphides. The zones are about 3 m wide. The main mineralized zone is more or less restricted to the intermediate flow unit and strikes roughly parallel to the contact with the intermediate fragmental unit to the north. An offset of the main vein between shafts 1 and 2 is probably best explained by right-lateral displacement on a north-trending fault (Figure 18).

A second quartz vein which ranges up to 90 cm wide is exposed about 75 m south of shaft 2 (Figure 18).

The quartz veins contain varying amounts of carbonate, muscovite, tourmaline, pyrite and arsenopyrite. Wall rock adjacent to veins is carbonatized and/or chloritized and contains various amounts of finely disseminated sulphides.

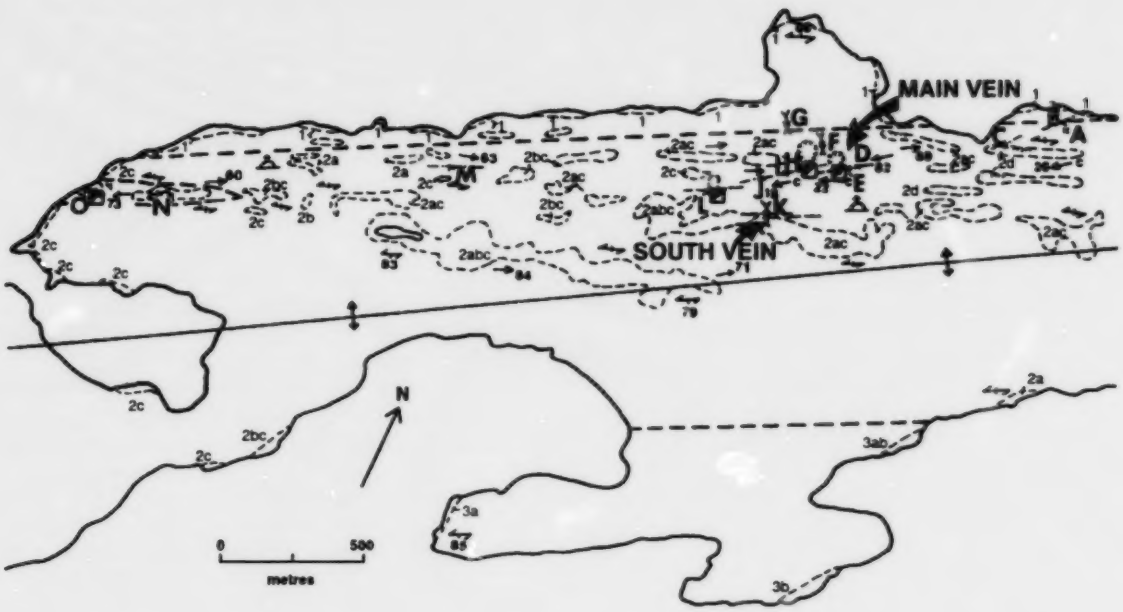
In general, the main vein and associated wall rock are quite low in gold content. Assay results reported by Denison Mines Limited ranged up to a maximum of 0.05 ounce per ton gold (RGFK). This was confirmed by a number of grab samples collected by members of the field party. Most of these samples are below detection limits for gold and silver, with a maximum of up to 2090 ppb gold (Table 8, samples A to O).

A previously unworked and undescribed mineralized zone was observed along the south shore of the property about 325 m south of the main zone (Figure 18). It is poorly exposed, but appears to consist of a rusty zone with up to 20 percent finely disseminated arsenopyrite and pyrite cut by thin, bluish grey quartz veinlets. The zone strikes at about 080° and is exposed over a strike length of 5 m and width of 2 m. Examination of a polished thin section of the disseminated sulphides revealed arsenopyrite as the dominant sulphide mineral, followed by pyrite (variably altered to marcasite and/or hematite and goethite, with traces of sphalerite and chalcopyrite. A grab sample of this material assayed 3830 ppb gold and 7.5 percent arsenic (Table 8, sample P).

A quartz vein which may be a strike extension of the main vein is exposed near the shoreline, about 300 m southwest of the westernmost exposure of the main vein (Map 2549, back pocket). The vein is poorly exposed in a small pit above a 10 m long adit, which was apparently driven south from the shoreline in a failed attempt to intersect the vein at depth. The vein in the pit is about 25 cm wide and has an attitude of 095/85S. It consists of white quartz with about 5 percent finely disseminated pyrite and minor arsenopyrite. Thomson (1937) reported a grab sample of mineralized quartz contained 0.01 ounce per ton gold. A grab sample of quartz with pyrite collected by the 1986 field party contained 75 ppb gold (Table 6, sample 17).

J.P. RAPSKI PROPERTY (13)

This property consists of a small island in Rush Bay designated as Patented Mining Location M11. Near the east shore a small adit (4.6 m long) was driven westward on a vein. It lies about 500 m west of the Nonesuch shaft (Noranda Exploration Company, Limited property). A "vein", which consists of abundant quartz veinlets in



LEGEND

1 intermediate tuff breccias
2 intermediate volcanic rocks
- a pillowed flow
- b porphyritic flow
- c amygdaloidal flow
- d pillow breccia

3 mafic volcanic rocks
- a amygdaloidal flow
- b pillowed flow

4 quartz feldspar porphyry intrusive rocks

SYMBOLS

- shaft
- outcrop
- escarpment
- pillow tops
- geological contact
- muck pile
- anticlinal axis
- quartz vein
- trench
- foliation
- mineral lineation
- crenulation lineation
- grab sample location (see Table 8 for results)

Figure 18. G. Pogson property (Three Friends occurrence).

highly schistose and carbonatized intermediate volcanic rocks, is exposed in the adit and on surface in a trench just west of the adit. The vein is up to 60 cm wide and trends 057/75N.

Grab samples collected by members of the 1986 field party contain 415 ppb and 295 ppb gold from the vein in the adit and trench respectively (Table 6, samples 54A and 54B).

SELCO EXPLORATION COMPANY LIMITED (14)

Three diamond-drill holes were drilled in 1966 on electromagnetic conductors. Two holes are located on land north of Rush Bay, the third was drilled from the ice just east of Rush Bay.

The two diamond-drill holes north of Rush Bay intersected intermediate to mafic fragmental volcanic rocks with intercalations of fine-grained argillaceous to siliceous sedimentary rocks, locally strongly graphitic and with rounded pyrite nodules. The diamond-drill log for the third hole, east of Rush Bay, was not found but the Data Series Map for this area (Rivett and McTavish 1980b) indicates that the hole intersected intermediate to mafic fragmental volcanic rocks intercalated with exhalite. Pyrite, pyrrhotite, graphite, sphalerite and trace chalcopyrite are also indicated. Assays were not reported on the diamond-drill logs.

SQUAW LAKE OCCURRENCE (15)

This occurrence is also known as the Longe claims (Davies 1978). A claim group was staked by R. Longe and some trenching was done in 1969. Noranda Exploration Company, Limited carried out ground magnetic, electromagnetic and induced polarization surveys in 1970. In 1972, Kerr Addison Mines Ltd. drilled one hole under the main showing.

The area is underlain by altered tonalite and associated quartz-plagioclase porphyries of the Canoe Lake

TABLE 8. GRAB SAMPLE ASSAYS, G. POGSON PROPERTY (THREE FRIENDS OCCURRENCE), CLEARWATER BAY AREA.
(see Figure 18 for sample locations)

Sample	Au (ppb)	Ag (ppm)	As (ppm)	Grab Sample Description
A	305	<2	1.4%	sheared metavolcanic with py & asp
B	12	<2	5000	q.v. with tour, py & asp
C	<2	<2		q.v. with 2% py
D	<2	<2		q.v.
E	<2	<2		q.v. with tour
F	<2	<2		sheared metavolcanic
G	<2	<2		sheared metavolcanic
H	15	<2		q.v.
I	<2	<2		q.v.
J	<2	<2		q.v.
K	<2	<2		q.v.
L	3	<2	9500	q.v. with py & asp
M	<2	<2		sheared metavolcanic with fuch & py
N	<2	<2		q.v. with 2% py
O	2090	<2		q.v. with 5% py
P	3830	<2	7.5%	sheared metavolcanic with asp, py and q.v.

stock intruded into mafic volcanic rocks and synvolcanic mafic intrusive rocks.

Chalcopyrite, pyrite, pyrrhotite and locally sphalerite are concentrated along widely spaced fractures and shear zones. Chalcopyrite is locally altered to malachite. Pyrite and chalcopyrite also occur as minor disseminations within massive phases of the Canoe Lake stock. Davies (1978, p.119) reported:

> The main showing, which is about 75 feet (22 m) from the shore of Squaw Lake, consists of a mineralized shear zone in quartz diorite close to the contact with mafic rocks.

King (1972, p.36) reported that "sampling of the main trench across a width of 16 feet (5 m) by Noranda Exploration Company, Limited gave values of 0.44 percent copper, 0.5 ounce of silver per ton". The Kerr Addison drill hole intersected a 5 foot (1.5 m) section containing 0.63 ounce per ton silver, 0.36 percent copper and 0.01 ounce per ton gold, a 6.4 foot (2 m) section of relatively unmineralized rock, followed by a 4.7 foot (1.4 m) section containing 0.68 ounce per ton silver, 0.52 percent copper and 0.01 ounce per ton gold located vertically below the main trench (Davies 1978, p.119).

Grab sampling of disseminated and shear zone hosted mineralization along the shoreline of Squaw Lake indicated values of up to 590 ppm copper, 10 ppm silver and 70 ppb gold (Table 6, sample 99).

VICTORIA ISLAND OCCURRENCE (16)

Two occurrences of quartz veins with arsenopyrite occur on the north side of Victoria Island. A pit about 3 m by 2.5 m was excavated near the shoreline on the north-central part of the island by H. Foster in 1900 (Chisholm 1949). A second showing on the northeast tip of the island was traced by stripping over a length of 46 m in 1949, on claims held by H. Palmason (Chisholm 1949).

The north side of Victoria Island is underlain to the west by felsic volcanic rocks which are predominantly fine-grained, highly schistose and sericitic tuffs with subordinate tuff breccias and lapilli tuffs in western exposures. The felsic volcanic rocks give way to intermediate tuffs and lapilli tuffs to the south and east. Intermediate pillowed to massive amygdaloidal flows are exposed on the west side of a small bay in the north-central part of the island. On the east side of the bay, a small amount of thinly laminated interflow sedimentary rocks strike north-northeast with a steep northwesterly dip. These are intruded to the east by a massive magnetic gabbro to quartz gabbro sill. The sill is up to 200 m thick and strikes parallel to bedding in the sedimentary rocks. A quartz-plagioclase porphyry about 100 m wide intrudes the intermediate volcanic rocks on the north-central tip of the island. A zone of high schistosity and associated sericitization and carbonatization up to several hundred metres wide trends easterly across the north half of the Island. This zone of moderate to intense deformation appears to be an east-northeast splay off the main part of the Crowduck Lake–Witch Bay shear zone.

The showing with the pit on the north-central tip of the island occurs within the quartz-plagioclase porphyry intrusion. It consists of a weak network of subhorizontal and subvertical quartz veins over a width of about 2.5 m. Subvertical veins strike 045° with a steep southeasterly dip. Veins consist of grey quartz with localized concentration of up to 20 percent medium-grained arsenopyrite and minor amounts of pyrite.

A grab sample collected by Chisholm (1949) assayed trace amounts of gold. A grab sample of quartz with

about 10 percent arsenopyrite collected by members of the 1986 field party contained 120 ppb gold and 3.5 percent arsenic (Table 6, sample 73A).

The showing on the northeastern tip of the island occurs within the gabbro sill. It consists of a zone of highly schistose and rusty gabbro that is up to 2 m wide and contains quartz veins up to 30 cm wide. The zone was traced over a strike length of about 46 m (Chisholm 1949). It strikes at 050° and dips subvertically. Quartz veins contain ribbons of coarse-grained massive arsenopyrite and minor pyrite and chalcopyrite.

A grab sample of massive arsenopyrite collected by Chisholm (1949) assayed 0.01 ounce per ton gold. A grab sample of quartz with about 20 percent arsenopyrite collected by members of the field party contained 115 ppb gold and 10.8 percent arsenic (Table 6, sample 75).

WHITING PROPERTY (UNICORN OCCURRENCE) (17)

This property consists of patented mining location P308 on the northwestern part of Zigzag Island. Work on the property consists of a shaft estimated to be 10 to 15 m deep and reportedly excavated around the turn of the century (Davies and Smith 1988), and a small pit located about 800 m west of the shaft near the shore, on the southwest tip of the location.

The property is underlain by intermediate, massive to pillowed flows which are locally plagioclase-phyric and amygdaloidal. These interdigitate with massive mafic flows to the west which are overlain to the south by thinly bedded mudstones and siltstones. Bedding strikes easterly with a steep southerly dip.

Near the shaft, a massive white quartz vein was traced by field party members intermittently over a strike length of about 100 m. The vein strikes from 045° to 065°. It ranges from 1 to 2 m in width. The vein contains various amounts of carbonate and black tourmaline and minor to negligible arsenopyrite. The wall rock is moderately altered to sericite and/or chlorite with some carbonate. The schistosity strikes east-northeast and dips subvertically.

Results of analyses of grab samples collected by the field party are as follows: quartz with arsenopyrite and tourmaline from the shaft—825 ppb gold and 2.6 percent arsenic (Table 6, sample 29A); quartz with arsenopyrite from vein exposed along shoreline about 60 m southwest of the shaft—22 ppb gold and 3400 ppb arsenic (Table 6, sample 28); quartz from vein along shoreline about 40 m northeast of the shaft—gold below detection limits (Table 6, sample 30).

The pit on the southeastern tip of the location contains large pieces of quartz float, but no vein was exposed due to the poor condition of the pit at the present time. The size of pieces of quartz float indicate that the vein is at least 30 cm wide. Sulphides are locally abundant and consist of arsenopyrite, galena, sphalerite, pyrite and chalcopyrite. Several small quartz veins with minor arsenopyrite are exposed along the shoreline southwest of the pit. They are up to 10 cm wide and have an attitude of 060/65SE.

A grab sample of quartz float with abundant sulphides was collected by members of the field party and contained 155 ppb gold, 7 ppm silver, 1.16 percent arsenic, 1490 ppm lead, 730 ppm zinc and 81 ppm copper (Table 6, sample 27A). A grab sample of the smaller quartz veins southwest of the pit contained 5 ppb gold and 1200 ppm arsenic (Table 6, sample 27B).

A grab sample from this location collected by Thomson (1937, p.30) assayed 0.02 ounce per ton gold.

Recommendations for Future Exploration

The area described in this report is considered to have potential for economic concentrations of gold. The areas of greatest potential are probably within the Crowduck Lake–Witch Bay shear zone and its associated splays.

Many recent studies on "greenstone" hosted gold deposits in the Superior Province of Ontario have shown these deposits to occur in zones where the rocks have had a structurally induced high permeability relatively late in their development (e.g., Colvine et al. 1984). The deposits occur in fault or shear zones and have broad zones of alteration spatially associated with them.

Gold, however, is not uniformly distributed along zones of deformation and alteration, e.g., along the Crowduck Lake–Witch Bay shear zone.

In this zone, based on empirical evidence, there seems to be a good correlation between the locations of gold occurrences and high competency contrast of rock types. For example, mineralization at the Echo Bay occurrence and the Gauthier and Nonesuch occurrences occurs at contacts of rocks characterized by competency contrast, e.g., they occur in highly sheared intermediate volcanic rocks between two large intrusions. The intrusions are the Rush Bay stock to the north and a large gabbro sill to the south.

Additionally, favourable sites for gold mineralization may occur where there is an abrupt change in the trend of the shear zone. This was observed at the Nor Penn occurrence in the Rat Portage Bay area east of the present map area (Ayer and Gil 1985), and on the southwest tip of Corkscrew Island in the present area. The gold mineralization at the Nor Penn occurrence is in the northern part of the Crowduck Lake–Witch Bay shear zone at a point where it is deflected from an easterly to a southwesterly trend. Previously unrecognized gold mineralization also occurs in a similar environment at the southwestern tip of Corkscrew Island. Here foliation in the Crowduck Lake–Witch Bay shear zone changes from an easterly to northeasterly trend. Breccia zones up to tens of metres wide occur near the southwest tip of Corkscrew Island and on small islands east and west of the point. Highly altered, angular volcanic fragments occur in a matrix of quartz and carbonate with fine- to coarse-grained pyrite disseminated in the fragments and the matrix. Four grab samples collected by members of the 1986 field party, in scattered locations over a distance of about 500 m, all indicated highly anomalous gold values ranging from a low of 360 ppb to a high of 1235 ppb (Table 6, samples 125 to 127).

During the mapping, grab samples were collected by members of the field party throughout the map area. Sample locations are indicated on Map 2549 (back pocket). Corresponding assay values and coded information on the nature, width and strike of the sampled zone are given in Table 6. Many of the assays obtained anomalous values of gold and/or other metals. Some of the sample locations listed in Table 6 are previously unworked and/or unrecognized zones of mineralization and are worthy of more detailed examination.

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